THE

ELECTRICAL REVIEW.

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"ELECTRICAL REVIEW."

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THE

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1902 Edition

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THE ELECTROLYSIS OF PIPES.

THE rapid extension of electric traction in our large towns has naturally excited the fears of the owners of underground pipe systems that considerable damage might be done thereby to their property. They have been told, on the one hand, by electric tramway engineers, that their fears are exaggerated, as there is practically no corrosion of pipes with properly constructed tramlines; but on the other hand, the theoretical men have calculated appalling weights of metal which will, in course of time, be abstracted from their pipe systems by the vagabond currents of the electric railway. The parties interested in this important question might well expect to find an authoritative statement of the true state of matters in the lecture recently delivered by Mr. James Swinburne to the Incorporated Gas Institute, but in this expectation we fear they will be disappointed.

Mr. Swinburne aims at taking an impartial view, and as he has appeared as an expert in the Law Courts and in the Committee rooms, sometimes for the electrical people, and sometimes for the gas and water people, he has had the great advantage of looking at both sides of the case from the point of view of an advocate. The result is that he takes no strong line in favour either of electric tramway companies, or of water and gas companies. He sums up by telling the gas engineers that undoubtedly there is a certain amount of electrolytic corrosion of their pipes, but whether it is serious or not has yet to be settled. He gives them rather cold comfort by adding that if there is any serious electrolytic corrosion the electric tramway people do far more damage to their own lead-covered cables than to the underground pipes. He advises the gas and water companies to look out for any signs of excessive corrosion of their pipes where they are subjected to the action of stray currents, and it must be admitted that it is only fair to ask the gas and water companies to give practical proof of damage before imposing liability on the electric traction people. In America, where electric tramways have been longer in operation on an extensive scale than in this country, there is, unfortunately, a great deal of evidence of serious corrosion of pipes brought about by the stray currents; but the conditions there are hardly comparable to what exist in this country where every possible care has been taken for years past to prevent anything more than infinitesimal leakage by compliance with the Board of Trade Electric Traction Regulations.

Mr. Swinburne gives for the benefit of the members of the Incorporated Gas Institute an explanation of the nature of electrolysis which is somewhat wanting in scientific accuracy. "The piece of metal which leads the electricity down," he says, "is called the anode, or way down. The piece which leads the electricity up again is called the cathode, or way up." This exchange of the etymologies of the anode and the cathode may be due to a slip of the pen rather than a contempt for the classics, but such an explanation can hardly

apply to his deliberate statement that water is an electrolyte, and that it is electrolysed into hydrogen and oxygen by the passage of the electric current. In no up-to-date text-book will this antiquated hypothesis be found. Water in its pure state is a non-conductor and is not electrolysed. It acts merely as a solvent for electrolytes, bringing them into such a condition of dissociation that they are readily electrolysed by the current, but it is not itself changed in any way. Mr. Swinburne may say that it does not matter much, as far as the corrosion of the pipes is concerned, whether it is the water or the salt it has dissolved which is split up, but it is well to be as accurate as possible in scientific matters, as one never knows when the little difference between a true and an approximately true knowledge of the facts may be of practical importance.

Mr. Swinburne explains how and where the stray currents from the tramway rails get into the waterpipes and where they come out near the power house. It is at the place of exit where the corrosion takes place, and a common device in practice for reducing corrosion is to connect this part of the pipe by metallic conductors to the negative pole of the generator. Mr. Swinburne commends this practice, though he also mentions that it may increase the evil by causing corrosion by shunt currents at high resistance pipe joints. He recommends water companies to introduce insulating packing in pipe joints with the view of reducing the electric current in the pipes, and thus reducing corrosion. But surely this will only intensify the evil, unless the whole pipe is made of insulating material. Practically the same current will flow in each metallic section of the pipe, whether the pipe joints have great or small resistance—any difference there may be being in favour of the pipes with low resistance joints. The higher the resistance of the pipe joints, the greater the corrosion caused at the pipe joints by shunt currents round the joints. We cannot agree with Mr. Swinburne when he says that: "If joints are insulated at very frequent intervals, the pipe will be so discontinuous a conductor, that it will pick up no appreciable current," since the pipes are embedded in the conducting soil, and we think he gives very injudicious advice to the gas and water companies when he advises them that insulation of pipe joints is a good measure.

Mr. Swinburne appears to think that the compulsory introduction of the insulated return feeder would throttle the electric traction industry. This, if the case, is unfortunate for the gas and water companies, for it appears, from a theoretical standpoint, to be the only satisfactory remedy yet devised for preventing electrolytic corrosion. Naturally, however, the electric traction industry must not be hampered on this ground, and, of course, as Mr. Swinburne rightly lays down, we must wait for practical evidence before we can declare for certain that electrolytic corrosion is a serious evil under the present conditions of working.

Progress at Bushy House.

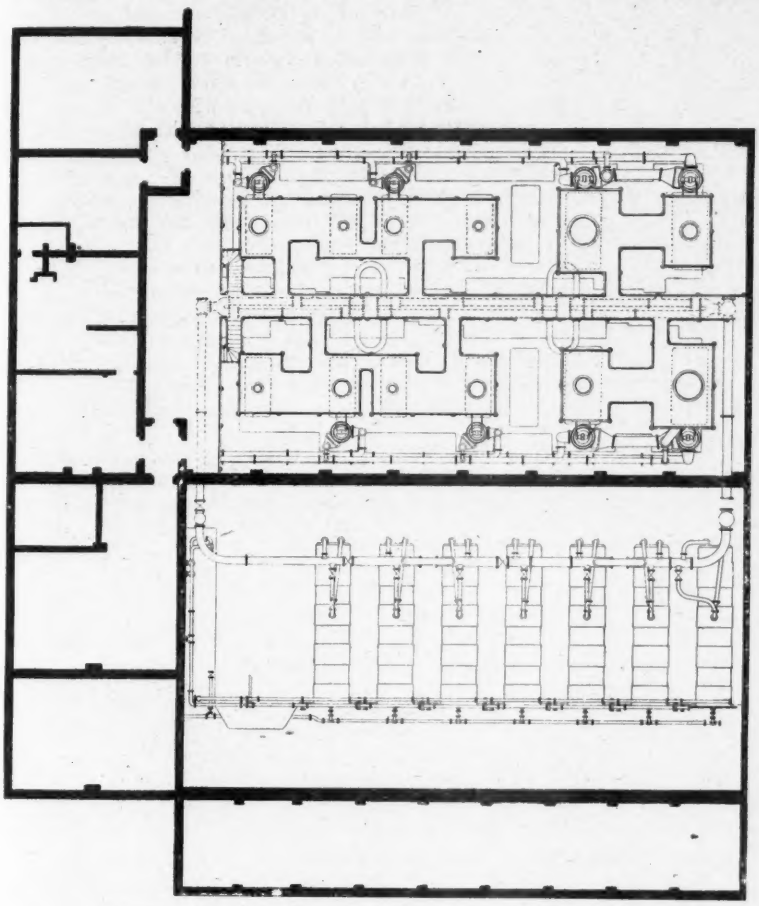
NOTWITHSTANDING the heavy rain on Friday a very fair number of Fellows of the Physical Society responded to the invitation of he Director of the National Physical Laboratory to meet at Bushy House. It was a happy idea to have no papers read, thus leaving Fellows free to inspect the laboratories at their leisure. This freedom was much appreciated; for, after all, it was the instruments and laboratory arrangements, together with the courteous hospitality of the Director and his staff, which called forth the enthusiasm of the visitors, and made them confess that it was one of the best meetings ever held by the Physical Society. The reading of papers was postponed until the extra meeting, to be held on June 20th at Burlington House. It will be remembered that, with the approval of the Sovereign, the Government allotted Bushy House, and the grounds adjoining it, for the purposes of a physical laboratory; and that an engineering laboratory was to be erected in the grounds. The Government granted £14,000 for the buildings and £4,000 a year towards the working expenses. The laboratory was also to receive the proceeds of the Gassiot endowment of about £458 a year, and it was estimated that from fees for standardising it would derive an income of £2,700. The institution was to be under the ultimate control of the Royal Society, and it was to be managed by an Executive Committee and a General Board, to which the Executive Committee were to submit yearly a report of past and prospective work. That is how matters stood in the early part of last year, and we have now to congratulate Mr. Glazebrook and Mr. Chree upon the substantial progress which, under their guidance, has been made in giving effect to the scheme. The old house at Bushy has now been converted into a laboratory capable of handling a large amount of good work in standardisation. All that seems necessary to ensure its success is that manufacturers and others shall send along such apparatus as they require standardised. The Engineering Department will carry out tests upon pressure and vacuum gauges, strength of materials, indicators and indicator springs, screws and screw gauges. The Physics Department is ready to undertake various tests on conductors and dielectrics, capacity, inductance, ammeters, voltmeters, and upon the magnetic properties of materials. As regards thermometry, a large portion of the thermometric work will be carried on at Kew; the work at Bushy will relate chiefly to the measurement of high and low temperatures. Photo-micrographic examination of sections of steel rails, and of other materials, chemical tests of materials, and their elastic properties will be undertaken in the section devoted to metallurgy. In the section of general metrology will be examined screws, gauges, scales and coefficients of expansion of bars and wires; also the standardisation of vessels used as measures in various industries, and weights and scales for laboratory and other purposes. The optical department proposes to examine lenses, lamps, the refractive indices and dispersion constants of optical materials, and perhaps will establish a standard of light for reference and comparison. So far as we were able to judge by casual inspection, the greatest progress has been made in the departments of thermometry and electricity. Metrology must necessarily take shape according to requirements, depending upon the class of work that comes to hand; but some excellent dividing engines are already installed. As regards optical work, weights and balances, there appeared to be a good deal yet to be done. The standardisation of laboratory weights should be a most important branch of this institution, and it is obviously to be dealt with in a most thorough manner.

Electricity at St. Louis Exposition.—Artificial light and heat for the purposes of illumination, as a means of decoration and as applied to industrial and domestic service, are to be made a leading feature in the Universal Exposition at St. Louis. More especially is this so in regard to electric light and heating. To put into practice what was a few weeks ago only an idea, the National Electric Light Association of the United States has just held a meeting, and resolved to work shoulder to shoulder to bring about the projected results; *i.e.*, that for the time being the Exposition shall be the emporium of the latest developments in all that relates to the new force. Those in Great and Greater Britain interested in the subject should communicate by letter with the resident representative of the St. Louis Exposition, Mr. George F. Parker, Sanctuary House, Tothill Street, Westminster, S.W.

CARDIFF CORPORATION TRAMWAYS.

(Concluded from page 987.)

Adjoining the power station, on a site of 2 acres, which is divided from the power station by the Roath Brook, the main car depôt is at present being erected; this, when complete, will accommodate 100 cars. The main portion of the depôt consists of four bays, each 320 ft. long, with three tracks in each, the total width being 136 ft. The whole of the flooring and tracks in the shed are supported on columns, leaving a clear space under the car 4 ft. deep.



Cardiff Tramways: Plan of Engine Room and Boiler House.

The foreman's office is on the first floor, and overlooks the whole shed from large bay windows. Offices for clerks, engineers, &c., are also provided.

At one end of the shed there will be an electrically-driven traverser operating the full width of the shed, for transferring cars either from one track to another, or into the repair shops beyond. The traverser pit is 25 ft. wide. Besides the four main entrances, cars can be taken into the depôt by means of side tracks running outside the building at one side direct to the traverser.

The contractors for the building were Messrs. D. W. Davies, whose tender for the work was £21,988; this firm also built the car depôt at present in use at the opposite end of the town, the second shed accommodating 32 cars. The lighting arrangements and tool equipment of both sheds are being carried out by the staff of the Tramways Department, under Mr. Ellis. The borough engineer has acted as architect in both cases.

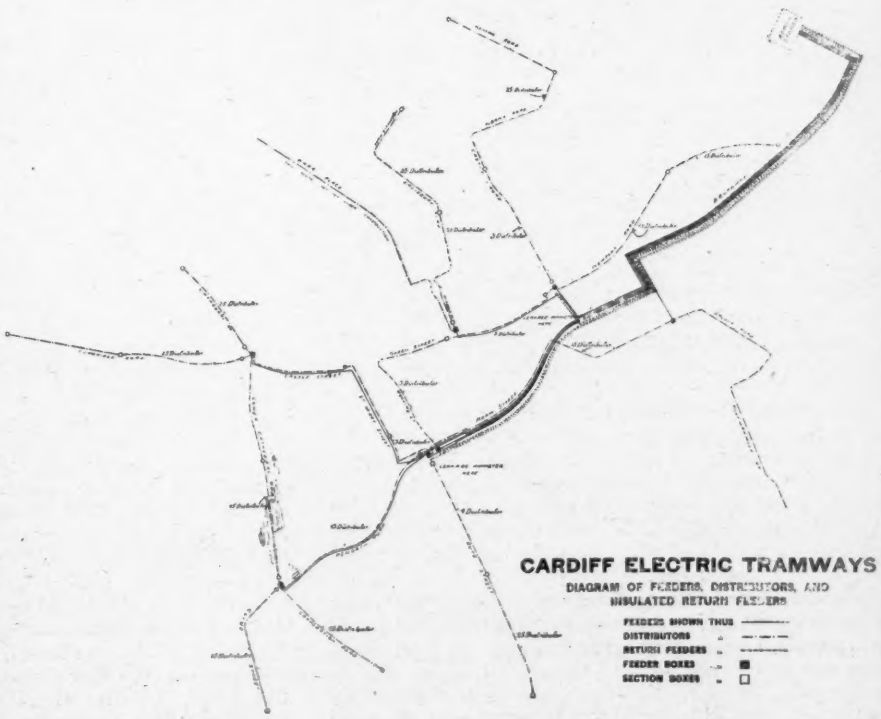
The feeders are single conductor plain lead-covered cables, drawn into Doulton earthenware conduits. There are seven main feeding points on the system, five of the feeders having a cross-section of 0·6 sq. in., one of 0·5 sq. in., and one of 0·4 sq. in. These feeders run direct from the power station to feeder pillars, specially designed by Mr. Ellis; each contains one main feeder switch of 600-amperes capacity, and four switches of 300 amperes each, a lightning arrester being also provided in each pillar. From these pillars cables are taken to the section pillars, from which the routes are fed. The section pillars contain two main switches, for cutting the distributors into sections, and four line switches.

The use of feeder pillars does away with the necessity of tapping the main feeders, the feeders being arranged so that each one feeds in three or four directions.

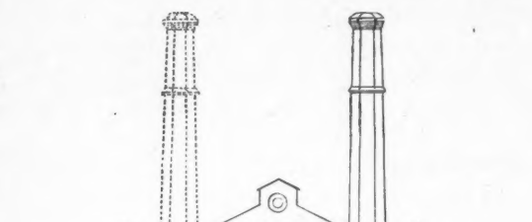
There are two return points on the system, from which insulated cables are taken back to the power station; from one of these three 0·8 sq. in. cables are taken, and from the other two 0·6 sq. in. cables. These are coupled to the rails by means of special clamps and copper bonds.

The distributors running along the several routes vary in size from ·4 sq. in. down to ·15 sq. in.

Three-core test cables are taken to the



various points of the system, one conductor being used for testing purposes, and the other two for telephones. Special telephone pillars are fixed every half mile along each route



and at different points in the centre of the town, and are in communication with the power station, central offices, depôts, &c.

The whole of the cables were supplied by the British Insulated Wire Company, Limited, of Prescot, whose contract was over £23,000. Doulton's conduits are laid throughout. The conduits are laid solid in concrete, and there are 30 ducts from the power station to the centre of the town, where the conduits radiate in all directions along the several routes. At the power station end the main line of conduits is coupled up to the power station by a subway 300 ft. in length, 10 ft. high and 4 ft. wide; this subway is in direct communication with the main switchboard.

The cars are fitted with a controller at each end, having four series notches and three parallel, also four notches for the electric brake. The electric braking is effected by connecting the motors as series generators in parallel, and in series with the same resistance as used ordinarily. Each car is fitted with an automatic circuit breaker, main motor switch, and main fuse, with magnetic blow-out, lightning arrester, and kicking coil.

The trolley standards are of the enclosed spring type, with a single spring under compression. The trolley standard is in one piece, made of malleable cast-iron. A super elevation stop is provided to limit the vertical motion of the trolley pole. Wood's trolley heads are used. The trolley stands are fitted with hand-holes for getting on the cable connections between the car and standard.

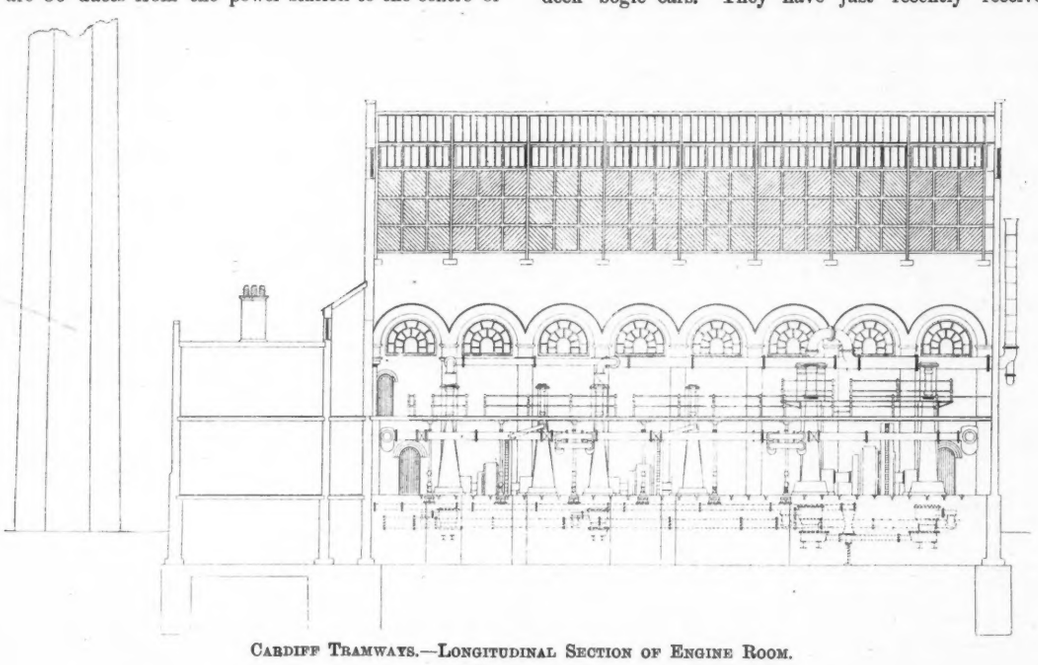
The four-wheel trucks are of the Brill No. 21 E type, with 30-in. wheels. The spring base measures 14 ft. 6 in., and the extreme length of top plate 15 ft. 7 in. The wheels have steel tires with wrought-iron centres, and were made by Messrs. John Baker & Co., and are forced on to the axles under a pressure of not less than 25 tons or more than 30 tons. The axles are $3\frac{3}{4}$ in. diameter, and the journal boxes are fitted with spring caps. The brakes are the ordinary link suspended type, with corning brake shoes. The cars are fitted with life-guards and fenders of the Tidswell type. The maximum traction trucks were supplied by Messrs. J. C. Brill & Co. The wheel base is 4 ft. and the driving wheel 30 in. with 20 in. pony wheels, with steel tires and wrought-iron centres.

Each car is fitted with two series-wound motors, each capable of a draw bar pull of 1,400 lbs., and at this load capable of propelling the car at a speed of 8 miles an hour with a pressure of 500 volts. They are capable of doing this for one hour with 100 per cent. overload for short periods.

The motors are four-pole type with the armatures geared to the car axles by single reduction spur gearing. The armatures are of the slot-wound drum type, and so wound that only two sets of brushes are necessary.

Each car is provided with a complete set of tools, including a traversing and lifting jack, &c.

The whole of the cars have been supplied complete with equipments, &c., by Messrs. Dick, Kerr & Co., Limited, of London, whose first contract was for the supply of 20 double-deck bogie, 20 double-deck four-wheel, and 14 single-deck bogie cars. They have just recently received an extension order for 20 double-deck bogie cars, and 20 double-deck four-wheel cars, making 94 cars in all. It is expected before the system is complete, that there will be at least 150 cars required.



Cardiff Tramways.—Longitudinal Section of Engine Room.

The general arrangement of plant, &c., at the power station, together with the cables, overhead equipment and cars, have all been carried out in accordance with the plans and specifications prepared by the borough electrical engineer and manager, Mr. Arthur Ellis, M.I.M.E., M.I.E.E., who, from the commencement, has been very ably assisted by his chief assistant, Mr. C. E. Davies, who is a man well versed in tramway work. Mr. Irwin acted as clerk of works for the buildings. It is expected that the system, when complete, will have cost over a half million of money.

Mr. Ellis, in addition to his duties in connection with the electric lighting and tramways departments, has, since January 1st, had to manage the horse tramways system as taken over from the old tramways company, consisting of 52 cars and 342 horses, together with the various depôts. The horse tramways will be gradually done away with. Since the opening on May 1st the traffic on the electric cars has been

enormous. Cheap fares have been adopted with a quick service, and stopping places have been fixed along the various routes.

From the new power station, which is now in operation, it is intended to supply current for electric lighting purposes in addition to the supply of power other than that for tramways, and it is mainly for this reason that the two large generator sets of 900 KW. are being installed, as it is expected that by next winter there will be a demand in motors alone amounting to nearly 1,500 H.P., the Corporation having recently entered into a contract with one of the largest shipbuilding and repairing firms in Cardiff for the supply of current for the driving of the whole of their machinery, which eventually will mean 500 H.P. alone. In addition to this firm there are applications in from several other very large firms for large amounts of power.

The whole of the current for lighting and power purposes generated at the main power station will be transmitted to a large sub-station in the basement of the Electric Lighting and Tramways Department's central offices, and it is intended to put in a main switchboard at this point, together with balancers, boosters, battery, &c., and to transmit the current from this central sub-station to the various sub-stations in the district. For a commencement two square inch feeders are being laid from the power station to the sub-station, and for the docks district alone two ·5 triple-concentric cables are being laid.

It is intended to change over the central area to continuous current during the present summer, as the existing lighting station is practically working up to its fullest capacity. It is also intended to light up the whole of the tramway routes electrically, and this will be done from the tramway poles, but the lamps will not be supplied from the tramway feeders or trolley wires, independent cables being laid for the purpose.

We have pleasure in expressing our great indebtedness to Mr. Arthur Ellis for the courteous manner in which he has come to our assistance in the preparation of the foregoing description of the Cardiff system.

OUR LEGAL QUERY COLUMN.

Questions addressed to the Editors for insertion in this column should be written on one side of the paper. Free use of fictitious names, &c. may be made. Answers are furnished by a duly qualified lawyer but the Editors cannot undertake to be responsible for the accuracy of the views which he may express.]

"INQUISITIVE" writes: "Thanks for your replies to my legal queries. I do not know whether you care to go further into the matter, but anyway, I will answer one or two of the points you raise.

"Query No. 2.—You say you do not see how this affects (1). Supposing your reply to No. 1 is correct, and that a consumer must pay for the units taken, irrespective of the fact that the meter ought not to allow him more than the amount prepaid, why should not this reply hold good in the case of a meter which intentionally allows him to go on without prepayment. I *am* speaking from my own (and public) knowledge in saying there is such a meter. 'It is the only prepayment (! ?) meter approved by the Board of Trade' (*vide* advertisement). By the way, when will this august body wake up, and deal with the approval of meters in a business-like manner?

"Question 3 (*a*).—You have apparently misunderstood this question, which is:—May the undertaker remove 'free' wiring and fittings against a consumer's wish. This point sometimes crops up where the consumption is too small to be remunerative.

"(*b*) and (*c*).—It is common practice not to trouble about getting a new tenant to sign an agreement of any kind so long as the owner of the house agrees not to distrain on the wiring and fittings.

"Question 4.—You are quite right as to *my* conscience, but I was thinking of the wicked consumer who *might* put in a check meter and fix it so near to the undertaker's meter as to interfere with the latter if in zinc case. Of course, there is no question as to the morality of such a proceeding, but is not a consumer within his rights in putting in a check meter wherever he likes in his own house?"

*** With further reference to question No. 2, it is presumed that in the prepayment meter to which our correspondent refers, after a coin has been placed in the slot, the current is switched on for a definite period. During that period the consumer's lamps will burn at full pressure; but when time is up a resistance is thrown in automatically. We assume that it is competent for the consumer to switch off his lamps, and so prevent waste of electricity during the "dull" period, and if he fails to do this he will probably have to pay for additional units consumed. Our previous answer was based on the supposition that there was no dial on the meter to register the number of units consumed, but merely a dial to show how many coins had been dropped in.

With regard to question 3 (*a*) we are of opinion that undertakers could not remove "free" wiring fittings against a consumer's wish.

3 (*b*) and (*c*).—We refer to our previous answer.

4. A consumer is within his rights in putting a check meter wherever he likes in his own house. So is a landowner within his rights in growing wheat in his field and in allowing it to lie there for the purpose of attracting his neighbour's pheasants; the distinction being that the law cannot touch the latter gentleman, no matter what his intention may be. Our correspondent must surely recognise that the question whether the consumer is acting fraudulently or not is for a judge or jury to determine.

PARLIAMENTARY.

LONDON UNITED TRAMWAYS.

ON Tuesday last week Mr. MOON, K.C., stated that with reference to the chairman's suggestion on the previous day as to the construction of a short line to join the proposed system up to the London County Council's system at Tooting, he had communicated with the L.C.C. The matter, of course, had not been considered by the whole Council, but Mr. Benn had promised that if the Select Committee felt there was a necessity for such a connection he would recommend the Highways Committee of the London County Council to make it.

A large number of local witnesses were called in support of the purposes in the Bill.

Further evidence in favour of the Bill was given on Wednesday and Thursday of last week by various representatives of public bodies, through whose district the tramways are proposed to be taken.

Mr. W. J. BULL, M.P., giving it as his opinion that the extension of the line over Hammersmith Bridge was an essential link in the chain.

Similar evidence was tendered by Mr. E. COLLINS, who represents Hammersmith on the London County Council, and this witness said he considered the bridge quite strong enough to carry a tramway across it.

Mr. J. CLIFTON ROBINSON, the engineer to the company, stated that the proposed line would stop at the end of Bridge Street, and 300 ft. from Hammersmith Broadway. The original proposal was to carry the line right through so as to connect with the Richmond line, but that part of the Bill had been abandoned in deference to local opposition, and the objection of the London County Council on account of the crowded state of Hammersmith Broadway.

Mr. HOBSON, C.E., having given evidence to the effect that the construction of Hammersmith Bridge was sufficiently strong to allow of tramway traffic, the promoters' case was concluded, and the Committee adjourned.

On Friday, June 13th, the Bill came again before the Select Committee of the House of Commons, presided over by Mr. Compton Ricketts.

Mr. C. GILES, chairman of the Wimbledon Common Conservators, gave evidence in opposition to the proposed line up Wimbledon Hill, and said that tramway lines would considerably increase the present difficulties for traffic. He contended that the amenities of the district would be seriously injured by the frequent service of electric cars, and thought the line should be constructed south of the railway.

Mr. J. BENN, chairman of the Highways Committee of the L.C.C., said whilst the line from Richmond to Hammersmith was a desirable route, still it was the policy of the Council to discourage the entrance of private tramway undertakings into their area; Hammersmith Bridge was not, he thought, a desirable bridge for tramway purposes. The County Council would be quite willing to construct connecting lines up to the county boundary, and he was prepared to recommend the reconstruction of the bridge, which was the property of the L.C.C., who would undertake the whole responsibility of the rebuilding.

The CHAIRMAN said a difficulty arose from the difference between the southern line with full understanding that there would be connection with Hammersmith Broadway, and a line that might, or might not be, connected, and, perhaps, upon onerous terms to which the promoters might be subject. The Committee might think it a grave matter to sanction the use of the bridge in perpetuity for tramway purposes, and might pass a proviso for its use for a limited time. In any case it was desirable that the County Council should not be prejudiced by the passing of a Bill with embarrassing conditions, and some understanding, he thought, should be arrived at.

Mr. MOON, K.C., appearing for the L.C.C., said it was not possible to go beyond the assurance received from Mr. Benn, for the policy of the Council did not imply the exaction from the company of any conditions referable to tramways in any other part of London.

Mr. FITZMAURICE, the chief engineer to the L.C.C., contended that Hammersmith Bridge was not suitable for the service of a double line of tramways.

The Committee then adjourned.

On Monday last Mr. MOON, K.C., on behalf of the L.C.C., said he opposed the tramway to be constructed over Hammersmith Bridge.

After Mr. BALFOUR BROWNE had replied for the promoters, and the Committee had consulted, the Chairman announced that the Committee were unanimous in that they could not allow that portion of the Bill which proposed a line from the south side of Hammersmith Bridge to the Broadway. The Committee adjourned.

National Telephone (Kingston-upon-Hull) Bill.—This Bill, the object of which is to make further provisions with respect to the undertaking of the company in Hull, was before a Select Committee of the House of Lords, presided over by Lord Hawkesbury, on Wednesday last week. Mr. Balfour Browne, K.C., who appeared for the promoters, said the National Telephone Company had power to break up the streets and lay wires, but must first have the consent of the local authority, and various agreements were entered into between the company and local authorities, to terminate at six months' notice. At the time the agreements were made, however, the company had no fear of a termination of the power, as they had the monopoly. Under the agreements made the company had spent £103,000 in Hull. When it was decided that the local authorities had power to compete, the company made representations to the Postmaster-General pointing out that, unless they had some protection, the Corporation might deprive them of their wayleaves. In reply, Mr. Hanbury said he thought the Corporation would not do this, but they had done so in Hull, for they had given notice to the company to terminate the wayleave, and the company were now in Hull with £103,000 merely on sufferance. By the Bill the company wished to put themselves in the position which Mr. Hanbury intended them to be in, viz., under the protection of Clause 3 of the Telephone Act of 1899, which provided that when an existing company had, before the passing of the Act, under the license of the Postmaster-General, provided a public telephone service, and it was proposed to grant a new license to a local authority, the powers given to the existing company should continue for the period specified in the new license. The case of the Corporation of Hull was that they gave notice before this case came into existence, and, therefore, the clause did not apply. That, he contended, was a mere evasion.—Mr. Littler, K.C., contended that it was beyond the province of the Committee to deal with the Bill at all. The two parties had entered into a contract after the date when the Government Bill was introduced. Consequently the agreement was either binding or was not binding. If it was not binding it could be set aside by the Courts of law, and if it was binding there was no justification for Parliament intervening to set aside a contract deliberately entered into.—Mr. Balfour Browne argued that the objection was too late, because Earl Morley had considered the principle and allowed the Bill to come in. The proceedings were adjourned while the Committee consulted with Earl Morley, and on resumption the chairman stated that the objection of Mr. Littler was a valid one, and the Bill could not be allowed to proceed.

Birmingham and Midland Tramways.—This Bill has been ordered to be reported to the House for third reading.

Birkenhead Corporation Bill.—This Bill was before Earl Morley's House of Lords Committee on Unopposed Bills last week and was ordered to go forward.

Exeter and District Tramways.—This Bill was before Earl Morley's Unopposed Committee yesterday, and was ordered to go forward.

Leicestershire and Warwickshire Electric Power Bill.—This Bill which has already passed the House of Commons, came on Tuesday last week before Earl Morley's Committee of the House of Lords on Unopposed Bills. Mr. Bell, Parliamentary agent, stated that there were several important alterations in the clauses, and he referred to the protective clauses. The Chairman ordered the Bill to stand over in order that the town clerks and the Parliamentary agents might consult.

Petitions Withdrawn.—The Tyneside Tramways and Tramroad Company have withdrawn their petition against the Newcastle-on-Tyne Corporation Tramways, and the Newcaste-on-Tyne Corporation have withdrawn opposition to the Tyneside Company Bill.

Metropolitan Railway Bill.—The Great Western Railway Company have withdrawn their opposition to this Bill.

North Metropolitan Electric Power Supply Bill.—Petitions have been deposited in the Private Bill Office of the House of Lords against this Bill by the Wood Green, Edmonton and Tottenham Urban District Councils.

Pokesdown Electric Lighting.—The Bournemouth Corporation have deposited a petition in the House of Lords praying to be heard against the confirmation of the Pokesdown Electric Light Provisional Order contained in the Electric Lighting Provisional Orders (No. 7) Bill.

Metropolitan District Railway Bill.—This Bill was before the Standing Committee of the House of Lords last week with respect to Standing Orders not having being complied with. The Committee decided that the Bill might be allowed to proceed.

Halifax Corporation Bill.—The Standing Orders Committee of the House of Lords considered the Halifax Corporation Bill, and decided that Standing Orders might be dispensed with and the Bill allowed to proceed.

South Wales Electrical Power Bill.—This Bill came before a Select Committee of the House of Lords, presided over by Lord Hawksley, but as it was stated that all opposition had been withdrawn, the Bill was struck out of the list of opposed measures.

Salford Corporation.—This Bill was in a crowd of Bills to have been considered by Lord Hawksley's Select Committee of the House of Lords on Thursday last week. On the Bill being reached, it was stated that opposition had been withdrawn.

Newport Corporation Tramways.—A Select Committee of the House of Lords, presided over by Lord Hawkesbury on Tuesday, Wednesday and Thursday last week, considered the omnibus Bill of the Newport Corporation, which, amongst other things, seeks to empower the Corporation to construct about six miles of additional tramway. The estimates in the Bill include £110,000 for tramway purposes. The Bill has already passed the Commons. Practically the only opposition to the tramway proposals came from the Great Western Railway Company, who strongly objected to one of the tramways crossing a level crossing. After hearing the evidence, the Committee decided that the Bill might proceed with the exception of Tramway No. 1, which crossed the level crossing.

Electric Light in South London.—The South Metropolitan Gas Company have given notice of their intention to oppose the confirmation of the Electric Lighting Orders of Bermondsey and Woolwich which are contained in electric lighting Bill No. 8.

Southport and Lytham Tramroad Bill.—The Southport and Lytham Tramroad Bill was before a Select Committee of the House of Lords, presided over by Lord Brougham, on Friday and Monday. The object of the Bill is to extend the time limited for the acquisition of land and completion of works under the Southport District Tramway Act, 1889, and the Southport and Lytham Tramroad Act, 1900, for authorising the issue of preferred and deferred shares, and for other purposes. The only petitioner against the Bill was Mr. Charles Hesketh, through whose estate the road will run, and Mr. Talbot, on his behalf, contended that as the promoters were asking for an indulgence from Parliament, Parliament should also consider Mr. Heskett's request for a modification of a few of the terms of the agreement of 1899, which he considered disadvantageous to him. The Committee decided to give further protection to Mr. Heskett with respect to crossing the tramroad, and passed the preamble of the Bill.

Kent Electric Power.—This Bill was before the Chairman of Ways and Means as an unopposed measure on Tuesday, and was ordered to be reported to the House.

Hastings Tramways.—This Bill which has already passed the House of Lords, was on Tuesday before the Chairman of Ways and Means in the House of Commons as an unopposed Bill, and was ordered to be reported to the House.

South Wales Electrical Power Distribution.—On Tuesday this Bill was before the Chairman of Ways and Means in the House of Commons as an unopposed measure, and was ordered to go forward.

LEGAL.

ATTORNEY-GENERAL AND POOLE AND DISTRICT ELECTRIC TRACTION COMPANY *v.* MAYOR OF BOURNEMOUTH.

MR. JUSTICE SWINFEN EADY, in the Chancery Division last week, heard this action for an injunction to restrain the Corporation of Bournemouth from commencing or continuing to construct a tramway authorised by the Bournemouth Corporation Tramways Order of 1900, or the portion thereof which would be situated between the commencement of tramway No. 2, authorised by the Christchurch and Bournemouth Tramways Act, 1900, and the point where that line crossed the boundary of the borough, as situated at the date of the Act, or alternatively to restrain the defendant Corporation from continuing to construct the same portion, together with the plant and machinery for working the same, except in accordance with a system to be agreed upon between the plaintiff and the defendant Corporation, or, in case of difference, to be settled by the Board of Trade, in pursuance of the Act. Mr. Warmington, K.C., and Mr. R. J. Parker appeared for the plaintiffs, and Mr. Vernon Smith, K.C., and Mr. Charles Church for the defendants.

The plaintiffs' case was, that the Poole and District Company owned and worked certain existing light railways constructed under an order dated 1899 on the west side of the Bournemouth borough boundary. By the Christchurch and Bournemouth Tramways Act, 1900, they were authorised to construct and maintain a line between a point within the boundary and Christchurch. The most westerly lines were No. 2, commencing in Christchurch Road and running to the boundary as it existed at the date of the passing of the Act, and No. 2A from the termination of No. 2 to High Street, Christchurch. Under the Act they were not to commence No. 2 line until August 1st, 1902, and if before that date the defendants constructed and completed the portion of their lines authorised by the order of 1900, situated between the commencement of No. 2 and the point where it crossed the borough boundary, to be worked by a system agreed between the company and the Corporation, or, in case of difference, to be settled by the Board of Trade, the powers in the Company's Act for the construction of No. 2 line should cease and determine. The defendants' tramway order incorporated a provision of the Tramways Act of 1870, but prescribed no time for the commencement of the works, and it provided that when the defendants had completed the portion between the termination of No. 6 (along the Christchurch Road, on the same lines as No. 2) and the county gates, the company might construct and maintain all works necessary for effecting junctions of line No. 2 with the defendants' trams. The area of the borough had been recently enlarged. The company were about to construct the lines authorised by their Act on the overhead system as adopted on their light railways. No part of the tramways authorised by the defendants' order had within a year from the date of the order, or by March 9th, 1902, been commenced, and no power for an extension of time had been given by the Board of Trade, so that the powers of the

defendants under their order had ceased to be exerciseable, and the system had never been agreed or decided by the Board of Trade, but the defendants threatened to proceed at the cost of the borough fund to continue the construction of the lines in question, and intended to adopt the conduit system, which would render the running powers of the company difficult and costly. The company had informed the Corporation that what they proposed to do was illegal, and had asked for an undertaking, which was refused. If this was proceeded with, the plaintiffs would be put to heavy loss. The defendants denied the plaintiffs' statement that no part of the works authorised by the defendants' Act had been commenced within the stipulated time. They had, in fact, commenced the works long before August 6th, 1901. It was true that no agreement had been come to with reference to the system to be adopted, but the plaintiff company, having failed to agree to the system suggested by the defendants, the latter had applied to the Board of Trade, by whom the matter would be considered. Their powers under the order remained in full force, and they never had any intention of exercising them to the prejudice of the plaintiffs' rights, or in any other than a legal and proper way.

Mr. Warmington said, when the action commenced, the utmost the defendants had done was to get tenders for the construction of plant and make contracts for dynamos and cars. They had actually constructed no works. The question was one of the construction of the Act of 1870, which provided that if works were not completed within two years, not commenced within one year, or commenced, but the work suspended without reasonable cause, the powers given to the promoters should cease to be exercised unless an extension of time was granted by the Board of Trade. The Attorney-General now intervened, and said it was no answer to him for the defendants to say that since their powers had expired they had constructed certain works.

Mr. Vernon Smith quoted cases in which Section 18 of the Tramways Act of 1870 had been construed as meaning that the only evidence on which the Court could decide whether the event contemplated in that section, namely, non-commencement within a year, non-completion within two years, or suspension of the work without reasonable cause, had occurred, with the evidence afforded by the notice of the Board of Trade. Considerable inconvenience might follow if that were not the case, because after the Court had given a decision application must be made to the Board of Trade, which might be in conflict with the Court and decide in a contrary sense.

His Lordship: Is there any obligation on the Board of Trade to certify?

Mr. Smith submitted that if it did not the Court could not act, because the Board of Trade was placed practically in the position of a judge throughout the whole Act, and on them was thrown the onus of deciding what the promoters were to do and what powers they had. That furnished a strong ground for saying it was their duty to issue a notice if asked to do so. The section did not contemplate an appeal to the High Court but to the Board of Trade. Counsel next submitted that on the true construction of the Act they had substantially commenced works. The true view of the section was that "works" were something much larger than the actual tramway. If they had built the generating station, and put in dynamos, and had given orders for rails and cars and everything necessary to lay the tramway, according to the contention of the plaintiffs they would not have substantially commenced the works. Bournemouth was a pleasure resort, and it would have been inconvenient to visitors and inhabitants if they had commenced to break up the roads and lay the rails within the first year. The Corporation had required land, and entered into contracts involving £100,000, and it was idle to say that these works, if substantially commenced, did not save the rights of the Corporation.

In giving judgment, his Lordship held that it would be too narrow a construction to hold that the "works" meant the actual tramlines, and he was of opinion that the defendants had substantially commenced the works within the 12 months of the date of the provisional order within the meaning of Section 18 of the Tramways Act, by having entered into substantial contracts for the supply of dynamos and cars, and having actually purchased sites for the erection of a generating station and offices. It was, in his opinion, proper, for the sake of convenience, to postpone the actual laying of the line and the interference with the streets to as late a period as possible. There would be judgment for the defendants with costs as between solicitor and client.

Satchwell *v.* Dunlap.

Mr. Justice Bigham, in the Commercial Court on Wednesday last week, heard the case of Satchwell *v.* Dunlap, which was an action brought by Mr. F. J. Satchwell, M.I.E.E., against Mr. F. W. Dunlap, also an electrical engineer, of 5, Warwick Court, Holborn, on a guarantee given by the defendant that on the successful flotation of a certain company the plaintiff should be entitled to remuneration for services he had performed on the defendant's behalf. Mr. Biron and Mr. Frampton appeared for the plaintiff, and Mr. Turrell for the defendant.

Mr. Biron said the plaintiff had had a great deal of experience in the matter of electric light, and he was approached with a view to making certain experiments to see whether a patent of the defendant's was practicable. The invention was ingenious, and consisted of a spiral coil of glass wire wound round an electric globe, giving it a lens-like quality. The plaintiff discovered that it could not be done in the way suggested by the defendant, because to put the coil on as a whole it would have to be heated to such an extent that it would infallibly crack the glass. He, however, thought of a scheme by which it could be put on in sections and the difficulty avoided. He made certain tests, which were so satisfactory that they approached him in October, 1896, with regard to a contract to be made between him and Mr. G. W. Smiley, to whom the defendant, Mr. Dunlap, and Mr. Quaine, were anxious to sell the patent with a view to turning it into a company. By the contract Mr. Smiley agreed, in consideration of the services rendered and to be rendered by the plaintiff, to pay him £100 in the event of the sale of the patent to a limited company. The plaintiff did not know Mr. Smiley, who had subsequently died, and he obtained from the defendant a guarantee, on which the present action was brought. The only defence was a suggestion that Mr. Satchwell did not in fact do the work. The patent was sold to the Spiral Globe Co. in 1899. Mr. Satchwell applied for his money, but was put off from time to time, no suggestion being made that he had not done the work, and done it well.

The plaintiff gave evidence in support of his case and said he had devoted his study to electric lighting appliances. He also had considerable knowledge of glass and glass blowing. He had been under-manager of the Sunbeam Company which made glass globes, and in 1896 he was manager to Mackey & Mackey, electric lamp manufacturers. The idea of the defendant's patent was to improve the power of the electric globe by putting a spiral coil round it. He made very satisfactory photometric tests both before and after the agreement, and afterwards assisted in the actual manufacture of the globes.

For the defence counsel stated that no services were rendered after the signing of the guarantee, and that the defendant admitted that he could not make the globes, and suggested the defendant should go to Müller, who did what he had failed to do.

The defendant, in his evidence, said the plaintiff attempted to make some of these globes, but the attempts were not satisfactory. The coils were too far apart, and could not be wound without breaking, and in joining there were lumps so that it was possible to see through them to the light inside. Witness spoke about it to Mr. Satchwell, who said that with a little further practice he might be able to make them in a satisfactory manner. He tried after that, but never produced anything that was satisfactory. He said as he could not make them to the defendant's satisfaction he would introduce them to a man who would do so, and they employed Müller, who did them in a satisfactory way, and was paid between £75 and £100. The globes were not wanted in large quantities, but merely for purposes of demonstration. The patent was sold to Smiley for a small amount, about £2,000 in cash and 5,000 shares, but witness never received more than £300, and the shares were worth nothing. The company, whose nominal capital was £150,000, was now in liquidation. It was not the plaintiff's idea that the coils should be put on in sections. He had never had any application for money from the plaintiff, and he was not in a position to pay it.

His Lordship thought this was a case that ought to be settled. There had been a great deal of delay in bringing the action, but he thought the plaintiff had done something. He suggested that there should be judgment for the plaintiff for £50 without costs, to be increased to £100 if not paid within a month.

Counsel agreed to these terms and the case terminated.

Enright *v.* Ormskirk U.D.C.

At the Ormskirk County Court last week, before his Honour, Deputy-Judge Goldthorpe, the Ormskirk Urban District Council were the defendants in a case brought by J. and J. S. Enright, consulting engineers, London, who claimed 10 guineas, to which they said they were entitled for the preparation of a preliminary report on the electric lighting of the town of Ormskirk. Mr. Crosfield Pearson (Messrs. March, Clayton & Pearson, Manchester) represented the plaintiffs, and Mr. R. R. Glover defended. It appeared that Mr. Enright prepared the report on a letter received from Mr. Chadwick, the defendants' surveyor, but it was contended on behalf of the defendant counsel that the surveyor was never authorised to ask for the report without first counting the cost. The jury gave a verdict for the defendants, each party to pay their own costs.

The Electric Installation Company, Limited, *v.* Dublin City Distillery Company, Limited.

At Dublin before Mr. Justice Boyd last week this motion was heard for discovery of documents on behalf of the plaintiffs. The action was brought to recover damages for breach of contract for the installation of electric light, &c., by the plaintiffs in the defendants' premises at Great Brunswick Street, Dublin, and for the return of the plant. Mr. Justice Boyd made the order sought.

Electric Motor Car Litigation.

Before Mr. Justice Grantham and a special jury in the King's Bench Division on Tuesday, the hearing of the action Société Anonyme d'Electricité et d'Automobiles Mors *v.* Friswell & Co., was commenced. Plaintiffs, a French company, manufacturing in Paris the well-known Mors electrical motor car, sued to recover the balance due of the price of three motor cars sold. The defendants, who are agents, and have a depôt for the sale of motor cars at Holborn Viaduct, pleaded that the cars were not delivered in accordance with the contract as to time, and, further, were not manufactured in accordance with contract, and they counterclaimed for £100 damages.

Mr. Rufus Isaacs, K.C., and Mr. E. Pollock appeared for the plaintiffs, and Mr. T. Terrell, K.C., and Mr. Grimwood Mears for the defendants.

In opening the case, Mr. Rufus Isaacs said the claim arose out of contracts entered into on January 29th, 1900, for the supply by plaintiffs of 12 motor cars of 4 H.P., known as the "Petit Duc" car, and for three cars of 6 H.P., which were described as dog-cart cars. The price of the former was £213 8s each car, eight of the latter £306 9s. each. The claim related only to two of the Petit Duc cars and one of the dog-cart type, the other cars having been delivered under the contract and accepted and paid for by the defendants. The terms agreed to were payment of one-third value as deposit at the time of the order and the remaining two-thirds on delivery from the factory in Paris. A clause of the contract sets out that the sale by plaintiffs was made "according to the conditions of sale of our catalogue. Nevertheless, this is merely intended as a guide to the dates, without any obligation on the part of the company to deliver within that time."

Mr. Terrell: That is not the translation of the document that I accept.

Mr. Rufus Isaacs: That is the translation that I am going to put upon it, and I shall say it is the right translation. The exact words, given literally, are, "Nevertheless, this date is not given except as a guide, without any obligation on the part of the company." His case was that the cars were delivered within contract time, and, further, that even if the defendants' view was correct, they had over and over again waived any right they might have. As to the defence that the cars were not of good workmanship, they had been tested by two gentlemen very well known as motor drivers, whose evidence would assist the jury in coming to the conclusion that nothing was wrong with the machines.

At this stage the Court adjourned.

London Provincial Electric Construction Company.

Mr. Justice Buckley, sitting for the disposal of company matters in the High Court of Justice on Tuesday, had before him a petition by J. W. Vickars for the winding up of the London Provincial Electric Construction Company, Limited.—Mr. Dunham, for the petitioner, said the company did not appear. There were negotiations proceeding on the subject, and, in view of this, he asked that the petition might stand over for a week. Certain conditions were embodied in a resolution which the company passed on Monday, and there was a likelihood of the petitioner's debit being satisfied.—His Lordship allowed the case to stand out of the list for a week.

CORRESPONDENCE.

Edison and other Accumulators for Electric Motor Cars.

In an article of your issue of the 6th inst., it is stated that the British Electromobile Company ran a distance of 95 miles on one charge with the Leitner accumulator, and that last November the same company ran 100 miles using the A B C (Oppermann patent) battery.

This statement which has been taken from the daily papers is inaccurate, and it would be unfair to Mr. Henry Leitner to allow it to pass unnoticed now that it has appeared in the Electrical Press.

The British Electromobile Company's car ran 95 miles (from London to Reading and back) last June using Leitner accumulators. The cells have given satisfaction since that date, and have proved themselves commercially successful, that is to say, the cost of their upkeep is reasonable. They give from 14 to 16 watt-hours per pound of cell, and can be maintained at an annual cost of from 10 to 20 per cent. of their first cost.

Last week the same company ran a car from London to Chippenham, a distance of 97 miles on one charge, using the same type of cell. The roads during the latter part of the journey were steep and very greasy. From a "road traction" point of view this 97 miles is far more valuable than the previous record of 95 miles. The car carried representatives of two of your contemporaries.

The 100 miles has not been run in this country, at least, not officially, and unless it is made upon a through route, such as the Bath or North Road, it is of little value as a comparative test.

When a car has been driven from London to Bath on one charge, it will be time enough to consider the Leitner battery beaten.

Theodore G. Chambers,
Managing Director,
The British Electromobile Company, Limited.

June 11th, 1902.

Equivalent Sine Curves.

I am glad to see by the paper on "Lag and Lead" in your last issue that Mr. Rhodes no longer thinks it quibbling to discuss this subject. It is, however, with the hope of coming to some agreement with him, and with those who agree with him in thinking that the "equivalent sine curve" is of any practical use, that I write again. The theory of the equivalent sine curve, as stated by Mr. Rhodes last week, amounts to this. If C be the alternating current in a circuit, V the P.D., and ϕ the phase difference as got by a wattmeter, then for theoretical purposes we may write—

$$\left.\begin{aligned} i &= C\sqrt{2}\sin(pt \pm \phi) \\ e &= V\sqrt{2}\sin pt \end{aligned}\right\} \qquad (1)$$

It is to be carefully noticed that the rate at which i and e vary will be quite different in practice from what they will be if given by equations (1). We replace the actual curves by bogus curves, which certainly have the merit of simplicity, but which will produce quite different effects on the iron and the choking coils in the circuit. The theory is altogether too primitive, and would prevent us anticipating the many curious results noticed by engineers.

Mr. Rhodes makes the admission that in the problem of the alternating current arc there are no equivalent sine curves. We cannot follow his statement that it is easy to tell in practice whether the current is lagging or leading by noting the effect on the power factor of placing inductance in the circuit. If we place inductance or condensance in circuit with an alternate current arc, the phase difference is increased, and our old question arises—Is the current lagging or leading initially? The answer is known, and has been given more than once by Dr. Sumpner.

There is one somewhat serious misprint in Mr. Rhodes's paper. He says that if the P.D. and current "occur simultaneously," then

$$I_1\sin(\alpha_1 - \beta_1) + I_3\sin(\alpha_3 - 3\beta_1) + \ldots = 0.$$

If to "occur simultaneously" means to "vanish simultaneously," then surely the conditions are

$$\begin{aligned} &I_1\sin\alpha_1 + I_3\sin\alpha_3 + \ldots \\ &= E_1\sin\beta_1 + E_3\sin\beta_3 + \ldots \\ &= 0. \end{aligned}$$

Your Reviewer.

"A Scandal which Everybody Admits."

As an old "Arcadian" pupil (at a paltry premium of 100 guineas per annum), and now a wicked consulting engineer, I have noted with interest Lieut.-Colonel Crompton's remarkable testimonial to his old pupils and his own works, as given in his evidence before the Committee of the Institution of Electrical Engineers (see p. 990 of your last issue).

Although there were in my time some 30 pupils, I, oddly enough, never heard of any of them getting their money back through lack of proficiency. Still, possibly, the "failure department" had not then been started.

Morgan Williams, M.Inst.C.E., M.A.

June 16th, 1902.

A Cable Test.

About 11 years ago I put down a power circuit of the fibre insulated and lead-covered Fowler-Waring cable, 19/14s, partly underground, and partly fixed to buildings. It became necessary to double the voltage; the cable was tested and showed the insulated res., core to lead, of one cable to be 2 megohms, and the other 1·8 megohms. No fault has occurred since it was laid.

W. A. Walton, A.M.Inst.E.E.

June 14th, 1902.

REVIEWS.

Municipal Affairs. By R. C. Brooks. London: P. S. King & Son. 1902. 2nd edition.

This is a bibliography of the world's municipal literature—a sufficiently comprehensive subject. The volume

divided into a subject index (including cities, States and countries), and an author list, the latter being confined to names only. As far as possible, all books, pamphlets, periodical literature and important reports of investigations bearing on municipal matters are included, and the references are entered under the names of cities and countries, as well as under topical titles, in alphabetical order. The subject index comprises about 12,000 different entries; the author list, 8,000 titles, under the names of 4,500 authors, and it is interesting to note that by far the greater proportion of the titles are English, though other countries are well represented. The work is undoubtedly one of great value for reference.

Practical Calculation of Dynamo-Electric Machines. By ALFRED E. WIENER.

This is the second edition of a very comprehensive work, in which particulars and examples are given of the calculations required in the design of dynamo machinery. In the preface the author claims that he has treated the subject in such a manner that, by the aid of this book, a person with no previous experience will be able to design any kind of continuous-current dynamo.

As stated in our review of the first edition, this is a claim which we cannot admit, as no text-book can possibly take the place of that intimate practical knowledge based on experience, which is so essential to the satisfactory design of any engineering structures, whether dynamos, engines, bridges, or anything else.

The book is divided into eight parts, each of which deals with a separate portion of the subject. These parts are divided into chapters, and these again are sub-divided into numbered sections. The numbering of the sections is consecutive right through the book, and in connection with a well arranged index and a table of all the symbols used, makes reference to any point an easy matter, and might well be copied by other authors.

After a few pages on the physical principles of dynamos, we come to Part II., in which the author deals with the calculation of armatures in the usual manner, but with the addition of a number of tables of densities, &c., all taken from actual practice, and therefore of considerable value in guiding the designer. Sec. 35 contains a valuable table and curve relating to rise of armature temperature, showing the extent to which it is affected by peripheral velocity, and by the ratio of pole area to total radiating surface.

Under the heading of "Field Magnet Design," examples are given of the application of calculations to almost every known form of field magnet, many of which are now obsolete; but we do not find any examples of magnet frames for enclosed motors, an omission which will perhaps be rectified in a future edition, as these motors are now being used so extensively that their design has become a matter of some importance. The only class of enclosed motors which receive attention are series motors for traction, and the calculations given relate rather to the performance of existing machines than the design of new ones.

The calculation of magnetising forces is very clearly given, and in addition a set of diagrams on page 354 show the grouping of magnetic circuits in various dynamos with their electrical analogues. In machines having several magnetic circuits, the calculation of the magnetising forces is often a stumbling block both to students and to practical men, and in such cases these diagrams will be very helpful.

On the subject of sparking, figures and formulæ, based on experiment, are given for the correct size of air-gap for sparkless connection. Unfortunately, in this section the particulars given are only applicable to smooth-cored armatures with copper brushes. Perhaps in a future edition the author will supplement this with figures and formulæ for toothed armatures and carbon brushes.

In connection with shunt motor design, the author points out, and gives a table to show, that the tendency to increase of speed, due to heating of magnet coils, may by proper design be counterbalanced by the tendency to decrease due to the heating of the armature winding, so that a practically constant speed may be maintained at full load irrespective of temperature. He also points out that the demagnetising ampere-turns on the armature, by weakening the field, tend to prevent drop in speed with increase of load due to armature resistance, so that, by designing a shunt motor to work with a fixed brush lead of the proper amount, it can be made to run at a practically constant speed with any load.

In Part VIII. are given examples of the calculation of dynamos of various types and outputs, and there are three appendices.

The first gives tables of dimensions of modern dynamos by Westinghouse, General Electric Company, &c.

The second gives tables of copper, iron, and German silver wire, and winding data; and the third relates to remedies for troubles in dynamos and motors in operation, such as heating, sparking, humming of the armature, &c.

In saying, as we have done, that we cannot agree with the author's statement that his book will enable inexperienced persons to design dynamos, we do not wish to appear to depreciate its value. Had he instead claimed that it would be of material assistance both to students and to those engaged in the practical design and construction of dynamos, we should have entirely agreed with him.

Electrical Engineering Testing. By G. D. ASPINALL PARR, M.I.E.E. London: Chapman & Hall, Limited. 1902. Price

This work is intended to be of use to students in technical colleges in the second and third years of their course, and to some extent to engineers in electrical works. It consists of 289 pages on testing, a section on jointing cables, and an appendix of about 150 pages containing proofs of formulæ, descriptions of apparatus, and various useful tables of constants, logarithms, &c. There are 128 separate tests, each comprising an introductory explanation of the object of the test, a list of apparatus requisite for the test, instructions for taking and recording the readings, and suggestions for inferences, &c., which may be deduced from the methods and observations involved—the whole scheme being very similar to that introduced by Prof. Ayrton at the City and Guilds Colleges many years ago, which has proved highly satisfactory in practice.

The tests are mainly such as can be carried out with the apparatus to be found in any well-equipped electrical engineering laboratory; the description of methods embody also full explanations of the theory of the tests where necessary. Errors do not appear to be numerous; the first half of fig. 62 is incorrect, and should be omitted, and the statements regarding the conditions to be fulfilled in order that a shunt motor may be self-regulating (p. 194) are of questionable accuracy.

The author's spelling of the word impedance is new to us (impedence), and the use of the term "secohms" is antiquated. The wholly wrong statement on p. 250 that the three-wire two-phase system is more economical in copper than the four-wire (merely because there are "only three wires") betrays lack of reading on the author's part.

The appendix on apparatus, although largely composed, no doubt, of the makers' descriptions, is likely to be extremely useful, and is very full, covering indicators, planimeters, testing sets, Kelvin balances, potentiometers, photometers, &c., and the tables are well selected and arranged. In conclusion, our opinion is that this book should be of great value to those for whom it is written; the demand for such a work is undoubted, and it is well adapted to fill the real need.

BUSINESS NOTES.

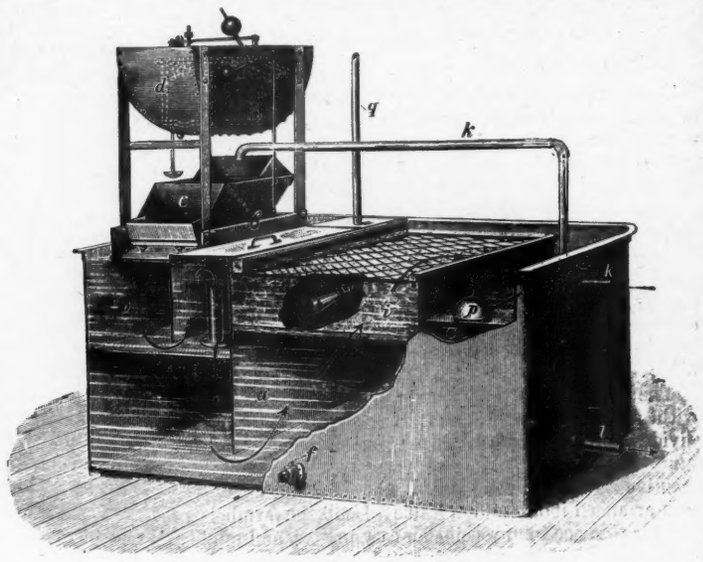
China.—La Compagnie Internationale d'Eclairage et de Tramways à Tient-Tsin is the name of a company which has just been formed in Brussels, with a capital of £250,000, to establish a system of tramways and a central electric lighting station at Tient-Tsin, China.

Holidays.—Those who are contemplating going for holidays shortly should obtain a copy of a neatly illustrated little pamphlet on "Holidays in Denmark and Scandinavia," at 30, Fleet Street, E.C. Some new and inexpensive tours in fresh holiday districts in Denmark are described.

Coronation Illuminations.—We learn that the Electrical Company, Limited, has received the order for the illumination of the Canadian Arch in Whitehall, London, and that more than 5,000 incandescent lamps will be used for this purpose. This is one of the most important pieces of electrical illumination for the Coronation festivities in the whole of the United Kingdom.

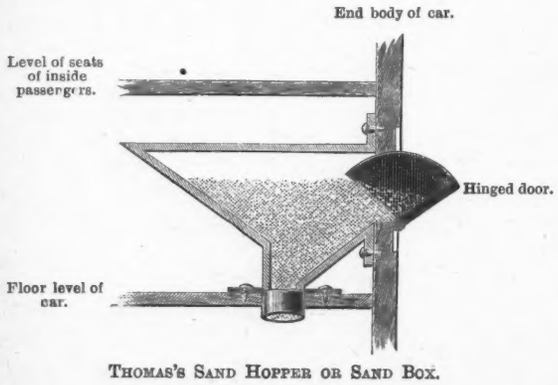
At the Holborn Restaurant there is an excellent electrical display. From the proprietor's own generating plant energy is taken for lighting about 2,500 incandescent lamps, 1,500 of these being enclosed in what are known as Micaylorlite reflectors. We note that Messrs. Defries & Co., who are the contractors for the electrical illumination of the front of these premises, 4, Ludgate Hill, E.C., are also using these reflectors.

The Bruun-Loewener Water Softener. — Speaking generally, all hard waters are made so by containing some salt of lime in solution. These salts are the carbonate and sulphate to which may be added the carbonate of magnesia, which acts in the same way as carbonate of lime, and may be removed by the same process and agencies. All water softening is done by heat or by chemicals, and with the ordinary lime salts the chemical process is the same, whatever apparatus be employed. The details of the apparatus differ. In that illustrated, a tank, *d*, contains the caustic milk lime, or soda salt, which it is desired to add to the water to be softened. Below it is a rocking vessel, *c*, with two chambers, into which the water to be softened flows alternately from a pipe, *k*. At each oscillation of the mixer, *c*, a definite quantity of water is allowed to escape from the chemical tank, *d*. The mixed water and chemical flows down by way of *b* into the main body of the tank, *a*, and in this tank the scale-forming matter is deposited and the softened water is taken away by the pipe, *i*, which is placed above a bed of filtering material. By means of further appliances, as ball valves, &c., the feed by way of *k* can be regulated to the demand, and the use of the oscillating chamber, *c*, maintains a constant ratio between the supply and the chemicals, which are kept constantly agitated in *d*. It is preferred to heat the water to be softened so as to facilitate the process. About 130° is advised as suitable. If cold, a somewhat larger settling tank becomes necessary. For London waters, either as supplied by the companies, or from chalk wells, the only chemical required will be caustic lime with the addition sometimes of some soda to deal with any lime sulphate, or a little alumino-ferric, to coagulate organic matters. A simple carbonate water is a very cheap water to treat, and the results are very perfect. A sulphate water can, of course, only be treated at the cost of leaving a quantity of soluble salt in the softened water, and care is required that such soluble salts do not become concentrated in the boiler. A blow-out at the bottom of the depositing vessel of the apparatus described serves to discharge deposit as it collects. To soften water will usually cost less than the coal wasted by the scale deposited from hard water. The apparatus described is made by Lassen & Hjort, of 52, Queen Victoria Street.



The Bruun-Loewener Water-Softener.

New Sand Hopper.—An improved hopper or sand box has been patented by Mr. H. N. Thomas, electrical engineer and manager of the Huddersfield tramways. The advantages claimed for this hopper over those in general use are as follows:—It can be refilled by either the motorman or the conductor whilst the car is running, or at any time, without having to disturb the passengers, raise cushions or seats, as in the ordinary type. It is more rigidly fixed than the ordinary type. There is no risk of spilling sand inside the car, which often gets into and grinds up the motor bearings; nor can the sand be spilt on and about the seats or amongst the cables when refilling, as in the old style. If sand should suddenly run short on a greasy rail and a down grade a fresh supply can at once be put in without causing a panic among the passengers by the conductor rushing in and asking them to rise whilst he takes up the seats and refills the hoppers. The box is also said to be cheap and durable, and the front hinged door being recessed into the panel, with a fancy scroll brass handle, painted and lined, is quite out of sight, and yet within easy reach and control of the motorman. The figure herewith shows a cross-section of the hopper.



Thomas's Sand Hopper or Sand Box.

Private Plant.—A very complete installation for electric light and power has been laid down at the Oldham Equitable Co-operative Society's central premises, to the designs and specifications of Messrs. Crews & Handford, of Manchester. There are two Lancashire boilers, supplied by the Oldham Boiler Works Company, Limited, and a Green economiser. The feed water and steam pipes are in duplicate. The dynamos and motors, and all the electrical work, were supplied by Messrs. W. B. Haigh and Co., Limited, of Oldham. There is one dynamo coupled to a Universal engine and two coupled to Willans engines, each set having an output of 172 amperes at 215 volts, 450 revolutions per minute. A smaller dynamo, of 33 amperes capacity, is coupled to a Westinghouse gas engine of the two-cylinder vertical type for light loads. The wiring is in steel tubing, partly in wood casing; there are 2,000 glow lamps, and eight motors of 1 to 10 B.H.P. The installation cost altogether about £7,000.

Catalogues.—Messrs. Clayton & Co., electrical engineers, of Union Works, Huddersfield, have issued an illustrated catalogue showing several of their designs of switchboards, switching apparatus, &c.

A new circular has been brought out by the Edison & Swan United Electric Light Company, in which they describe their new standard electric regulator clock, such as they are showing at the Wolverhampton Exhibition and at their London and Liverpool showrooms. This high-precision regulator is claimed to be most suitable for mansions, watch and clock makers, astronomers, and for all purposes where great accuracy in timekeeping is necessary. No winding is required, the clock having no weights or springs, and there being less than half the parts found in the ordinary clock. All of the parts are interchangeable and renewable at small cost. Two ordinary dry cells, as used for electric bells, will drive the clock for two years and upwards, when they will require renewing. High precision is secured by the perfect compensation of the pendulum, for variation in temperature, and by the simplicity of the movement, which ensures that the work done is perfectly constant in amount, notwithstanding changes of temperature and atmosphere. We understand that one of the clocks, tested by the Standard Time Company, and checked daily by an electric signal direct from Greenwich Observatory, for a period of eight months, only accumulated an error of 14 seconds fast. The clocks are also arranged with contacts for operating secondary dials, which dials may be placed in any position in a building.

An excellent catalogue, with some first-class illustrations of powerful engine lathes, which are manufactured in stock sizes by the Pond Machine Tool Company, of 136, Liberty Street, New York, has been sent to us.

A list of the Improved Electric Glow Lamp Company's direct and alternating current desk, ceiling, and ventilating fans has come to our hands, also one dealing with numerous accessories, including holders, cut-outs, switches, and other things for electric light and power work supplied by the same company.

Messrs. Davies, Kent & Stewart, of Berners Street, W, have issued a price list of ceiling roses and wall sockets for addition to their catalogue.

The firm of Siedel & Naumann, of 23, Moor Lane, Fore Street, E.C., has sent us a descriptive pamphlet of its metallic packing rings (Huhn's patent), which have been specially designed for high speeds, high temperatures and high pressures. They are claimed to be very reliable for use with superheated steam and to give the best results with high speeds. They have been tested with a speed of 2,000 strokes per minute. This metallic packing for stuffing

boxes consists of hollow metal rings, filled with a lubricant which resists the most intense heat. In the inner side of the rings small openings are provided to allow the continuous outflow of the lubricant, so that the piston rod and the working parts of the engine are always thoroughly lubricated. The use of these hollow metal rings as packing offers very numerous advantages which are stated in detail in the pamphlet, copies of which may be obtained at the above address. Full instructions are given for fitting the rings in the stuffing boxes, and also a list of navies, shipowners, ship wharves and electrical works on the Continent where they are employed. We learn that they are in constant use by English firms of the high industrial standing, such as Messrs. J. Howden and Co., Ferranti, Ltd., Galloway's, Ltd., Alley & Maclellan, Bickle and Co., Cole, Marchent & Morley, H. J. & A. Coulthurst, Davy Bros., and many others.

The Electrical Co., Ltd., has issued a new price list, No. 4A, in which a great deal of tabulated data and some illustrations appear of their single and multiphase alternating current, induction motors and transformers.

Messrs. T. Harding Churton & Co., of Atlas Works, Leeds, have issued several new lists descriptive of their machinery manufactures. No. 13 gives prices and particulars of their continuous current generators and motors of the "C" type with shunt, series or compound windings; for these we understand that a large number of orders are in hand, the sizes being for generators from 100 KW. and 70 KW. downwards, and for motors of 70-H.P., 50-H.P., 25-H.P., &c.; No. 14 details the "Atlas" continuous-current semi-enclosed motors; No. 15 is devoted to polyphase motors for two or three-phase currents; and No. 16 describes continuous-current multipolar generators and motors of their "RM" type. The firm has only recently commenced the manufacture of polyphase motors, and one of these of 6-H.P. has been successfully applied for working a grain elevator at the brewery of Messrs. J. Tetley & Sons, in Leeds.

The Typewriting Telegraph Corporation, Ltd., of Dashwood House, E.C., have issued an illustrated price list of the Steljes' type-printing telegraph instrument for use on telegraph and telephone lines.

The Electric and Ordnance Accessories Company, Limited, have sent us some advance sheets of Section "C" of their catalogue, illustrating and dealing with main switches, &c. These have been printed in order to give customers some idea of what the company are making. They will forward a copy of the list to anyone sending trade card.

Messrs. A. C. Wells & Co., of St. Pancras, are introducing a new hand-power lime-washing machine, by which lime, whiting, or cold water paints are applied at a speed of from 8 to 10 square yards per minute in a manner superior to brush work. It is claimed that one coat applied on rough surfaces by the machine is equal to two applied with brushes.

Messrs. Royce, Limited, are issuing a June stock list of continuous current dynamos and motors.

Messrs. Crompton & Co., Limited, are sending out circulars relating to their new carbons for coloured light.

The Arc Works Sports.—The thirteenth annual bicycle and athletic race meeting of the Arc Works Club, at Chelmsford, went off very satisfactorily last Saturday afternoon, notwithstanding the poor weather that prevailed. An excellent programme had been prepared, and the prizes were distributed by Mrs. Crompton. Mr. John Trotter, Lieut.-Col. Crompton, and other directors of the company, and a large number of friends were present.

Australia.—Messrs. Noyes Brothers, of Sydney, N.S.W., the Australian representatives of the British Westinghouse Electric and Manufacturing Company, Limited, have recently secured two important electric power contracts. One is for the complete conversion of the horse tramway system of Adelaide, South Australia, to electric traction. In all there are some 65 miles of track to be dealt with. The other contract is for a complete electric power installation to be put in the new railway works of the Queensland Government railways. These works are at Ipswich, near Brisbane, and the plant put down will consist of 800 H.P. of generating plant with numerous motors for machine driving. The system is to be of the two-phase type. The whole plant, steam, electric and auxiliary apparatus, is covered by the one contract, the price of which amounts to over a quarter of a million pounds.

Books Received.—"Pipes and Tubes: their Construction and Jointing," by P. R. Björling. London: Whittaker & Co., 1902. 3s. 6d.

"Programme of the Department of Technology of the City and Guilds of London Institute." Session 1902—1903. London: Whittaker & Co. 9d. net.

"Diagrams of Mean Velocity of Uniform Motion of Water in Open Channels; based on the Formula of Ganguillet and Kutter," prepared by J. P. Church. New York: John Wiley & Sons. 1902. $1.50.

Cricket: Tudor v. Chloride.—A cricket match was played on Saturday, 14th inst., between the employés of the Tudor Accumulator Co., Ltd., and the employés of the Chloride Electrical Storage Co., Ltd. The Tudor employés secured an easy victory over the Chloride employés, the result being as follows:—Tudor employés, 102; Chloride employés, 46. After the match was over both teams adjourned to the Tudor Co.'s works, where a substantial tea was partaken of and heartiest wishes were expressed for the success of both sides' employers. The match was played on the Tudor Club's ground.

Coronation Map.—Messrs. Fleming, Birkby & Goodall, Limited, belting and leather manufacturers, of Halifax, have issued a "Teon" map of London showing the Coronation procession routes for June 26th and 27th.

Electrical Wares Exported.

WEEK ENDING JUNE 18TH, 1901.		WEEK ENDING JUNE 17TH, 1902.	
Adelaide	Value £53	Auckland	Value £47
Alexandria	.. 1,616	Bangkok	.. 26
Amsterdam	.. 75	Boca	.. 487
Archangel	.. 245	Bombay	.. 730
Auckland	.. 85	Calcutta	.. 1,674
Bangkok	.. 215	Cape Town	.. 1,329
Berbice	.. 30	Channel Islands	.. 1,225
Bilbao. Teleg. mat. ..	.. 100	Christchurch	.. 84
Boca. Teleg. mat. ..	.. 390	Colombo	.. 111
Bombay	.. 290	,, Teleg. mat. ..	.. 76
Buenos Ayres. Teleg. cable ..	500	Copenhagen. Teleg. wire ..	81
Calais. Elec. detonators ..	50	Coronel	.. 323
Calcutta	.. 861	Durban	.. 410
Cape Town	.. 1,082	East London	.. 178
,, Teleg. cable ..	291	Gibraltar. Teleg. mat. ..	16
Christchurch	.. 67	Gothenburg. Teleph. cable ..	81
Colombo	.. 233	Halifax	.. 291
Copenhagen. Teleg. wire ..	374	Hamburg	.. 110
Durban	.. 499	,, Teleg. mat. ..	.. 225
Fremantle	.. 222	Hong Kong	.. 67
Hamburg. Teleg. mat. ..	300	,, Teleg. mat. ..	48
,, Teleg. apprts. ..	481	Madras	.. 90
Karachi. Teleg. mat. ..	.. 74	Malmo. Cable	173
Launceston	.. 76	Melbourne	.. 1,705
Lisbon	.. 75	North Atlantic. Teleg. cable ..	4,560
Lyttleton	.. 16	Perth	.. 72
Madras	.. 115	Piraeus	.. 53
Melbourne	.. 328	Port Elizabeth	.. 1,700
,, Teleg. wire .	.. 1,867	Rotterdam	60
Ostend	.. 29	,, Teleg. mat. ..	100
Otago	.. 40	St. Petersburg. Teleg. mat. ..	500
Penang	.. 40	Shanghai	.. 310
Port Chalmers	.. 55	,, Teleg. cable ..	.. 9,950
Port Elizabeth	.. 460	Stockholm, Teleph cable ..	282
Quebec. Teleg. cable ..	.. 153	Sydney	.. 644
Rockhampton	.. 300		
St. Petersburg. Teleg. wire ..	45		
Shanghai. Teleg. wire ..	.. 40		
Singapore	.. 61		
Stockholm. Teleg. wire ..	50		
Sydney	538		
Wellington	.. 220		
Total ..	£13,544	Total ..	£27,692

Foreign Goods Transhipped.

Fremantle. Elec. apprts.	Value £747	Boulogne. Elec. cable	Value £270
Gothenburg. Elec. apprts.	.. 25	Hong Kong. Teleg. apparatus	150
Hamburg. Elec. goods ..	.. 60	Paris. Elec. lighting goods	.. 297
Perth. Elec. supplies ..	.. 46		
Total ..	.. £878	Total ..	.. £617

Dissolutions and Liquidations.—A meeting of the Gateshead Electric and Mechanical Supply Company is to be held at Newcastle on July 18th to hear an account of the winding-up from the liquidator.

First meetings of creditors and contributories of the Meyra Electric Company, Limited, are arranged for July 1st at 33, Carey Street, W.C.

The Electrical Transmission Company.—We are asked to publish the following letter:—

"We have received several communications from our friends with reference to an announcement appearing in your last issue concerning the liquidation of the Electrical Transmission Company, Limited. We wish to point out that Mr. Ernest Scott, of 2, Talbot Court, Gracechurch Street, E.C., purchased the business, patent rights, &c., of the Limited Company in December, 1900, and this purchase, of course, rendered it necessary that the 'Limited Company' should be wound up. The business has, since then, been carried on under the title of the Electrical Transmission Company. The notices appearing are the usual formal notices connected with the winding-up of the Limited Company, and have no connection with the present concern.—The Electrical Transmission Co., A. B. RIGBY, *Manager*."

Imports of Foreign Electrical Plant.—May proved to be another quiet month as regards the importation of foreign electrical goods and apparatus into this country, the value amounting to only £53,361, which compares with £65,363 in the preceding month, and £90,281 in May, 1901. The shrinkage which is taking place in these imports is well indicated by the returns for the five months ending with May, which show a total of only £283,702, as contrasted with £498,599 in the corresponding five months of last year.

Jandus Patents.—We are informed that the Reason Manufacturing Company have recently signed an agreement by which they have become licensees of the Jandus Company.

Natal.—The value of the electrical fittings imported into Natal during the first quarter of the current year amounted to £12,000, as compared with £7,000 in the first three months of 1901.

Robertson Lamp Works.—On Wednesday, June 18th, a party of the Civil and Mechanical Engineers' Society paid a visit to the Incandescent Electric Lamp Company's works, Brook Green, Hammersmith, W.

Trade Announcements.—Messrs. Williamson and Joseph, Limited, of Northampton Works, Northampton Grove, Canonbury, London, N., are circularising the trade to the following effect:—"The Consolidated Telephone Construction and Manufacturing Company, Limited, have since the formation of this (W. & J.) Co. had a very considerable interest in it. It has been considered for some time that it would be advantageous that the two businesses should be worked under one control. The Consolidated Company have therefore taken over the business, and in future it will be worked under their name. All accounts will be payable to them, and they will discharge all liabilities."

The offices of the Mica Boiler Covering Company, Limited, have been removed to Cornwall Buildings, 36, Queen Victoria Street, E.C.

Mr. G. Braulik notifies that arc lamps of various types, open and enclosed, and also flame lamps, are to be seen burning at his Scotch office, 115, Bath Street, Glasgow.

The name of the Chloride Electrical Storage Syndicate, Limited, has been changed to the Chloride Electrical Storage Company, Limited.

ELECTRIC LIGHT AND POWER NOTES.

Belgium.—The electric lighting of the Borinage country, which has been under study for a considerable time past, has at last been decided upon. This important undertaking has for its object the lighting by electricity of Wasmes, Pâturages, and various other towns and communes in the district, besides supplying current to private and business houses for lighting and motive power purposes.

Bexhill.—A report on the second year's working of the municipal electric light works shows that the gross profit was £2,077. After placing £1,655 to the interest and sinking fund, there remains a net profit of £422. Mr. Robert Hammond was appointed to report upon the present position and future requirements of the works.

Blackburn.—The long controversy over tenders for new engines and dynamos at the Blackburn electricity works has at last been settled by the Town Council. About six months ago Prof. Kennedy was asked to advise the Corporation, amongst whom great difference of opinion had arisen as to the type of engine most suitable, the Electricity Committee and their engineers having originally recommended Belliss high-speed engines. The 100 odd tenders were submitted to Prof. Kennedy, whose report was recently received recommending the adoption of engines of moderate speed. The tender selected by Dr. Kennedy was that of Messrs. Dick, Kerr & Co., of Preston, for dynamos, with engines of 180 revolutions a minute by Messrs. Willans & Robinson, of Rugby, and he stated in a lengthy report his reasons for making that selection. The Committee thereupon asked Messrs. Willans & Robinson if they were prepared to amend their tender as to price, and also invited Messrs. Belliss & Morcom, of Birmingham, to do likewise. The former reduced their price from £18,880 to £18,127, and the latter from £21,031 to £19,313, and the Committee thereupon wrote Prof. Kennedy again, putting fresh facts before him, and asking for a supplementary report. The Professor, in response, said that, subject to guarantee of economy in steam consumption, and considering that a large proportion of the present plant at Blackburn was Belliss's, the Committee might safely accept Messrs. Dick, Kerr & Co.'s amended tender for Belliss engines. The Committee thereupon decided to recommend the acceptance of such tender, but at a subsequent meeting, after a lively discussion, reverted to Prof. Kennedy's original award, finally coming before the Council with a resolution (proposed by Alderman Crossley) for its acceptance and the adoption of Willans & Robinson's engines. The action of the Committee in obtaining a "supplementary" award was severely criticised by Councillor Hamer and others, and an amendment was proposed by Councillor Gregson that local engineering firms be invited to amend their tenders. After a three hours' debate of a quarrelsome character, the amendment was negatived by the casting vote of the Deputy Mayor (Councillor Tattersall), and the tender of Messrs. Dick, Kerr & Co. for dynamos, with Willans and Robinson's engines, was accepted.

Following on the remarks of Mr. Giles in his annual report of the electricity works last week, to the effect that want of proper condensing plant had caused a big expense on the year's working, the Electricity Committee have instructed him to prepare a scheme for the erection of such a plant.

Blackpool.—The T.C. last week discussed the action of the Tramways and Electricity Committee in deciding not to send a representative to the annual convention of the Incorporated Municipal Electrical Association. Alderman Grime characterised this action as a miserable, cheeseparing policy, and contended that the electrical engineer, considering how much money the Corporation had invested in electrical works, ought to be sent if they could not afford to send their chairman. He claimed that he saved the Corporation £500 last year on one item alone, through attending the convention. Mr. W. Challoner agreed that the head of the electricity department, and the engineer, ought to go to such gatherings, as they were highly educational. The matter was referred back to the Committee for re-consideration.

British Guiana.—The Demerara Electric Company now controls the tramways and lighting in Demerara, British Guiana, the gas company having closed down its works. An extension of the plant at the power station has been decided upon in consequence.

Burton.—Out of the profits of the electric light department for the past year, which amounted to £545, £520 is to be repaid to the gasworks department, on account of the £1 020 advanced by that department, and the balance of £25 has been carried to a new account to be called a renewal fund.

Bury.—The electricity accounts show that for the past year the gross profit amounted to £2,366 10s. 6d., as against £1,274 12s. 6d. in the previous year. The working expenses had been very considerably reduced, but the interest account had risen something like £430, and the sinking fund had also risen. Compared, the interest and sinking fund was £2,515 7s. 9d., against £1,932 5s. 3d. The net loss this year was £158 as against £657 last year. It is thought that next year there will be a profit instead of a loss. The consumers are 51 more, with 6,109 8-C.P. lamps. The total number of consumers is 305, with 24,668 8-C.P. lamps. The output has increased this year by 62,090 units, equal to 23 per cent. For motors and hiring purposes there were 59,773 units sold, and last year 24,471, increase 144 per cent. There have been 19 motors, equal to 89 H.P., let out on hire during the year. The total number of motors now in use is 48, and the total horse-power 187.

Colchester.—Colonel Smith, R.E., L.G.B. inspector, held an inquiry last week into the application of the Corporation for leave to borrow £8,500 for further electric light extensions. There was no opposition.

Dartford.—Nernst lamps are to be substituted for the existing incandescent electric lamps at Dartford for a portion of the street lighting.

Dewsbury.—The Corporation have made arrangements with the B.E.T. Company to lay in the trench in which the cables for the tramways will be laid from the electricity works to the Market Place, three lines of pipes, through which additional electric lighting mains may be drawn as required, the Corporation to pay the company a proportionate cost of the trench.

Hellingly.—Electricity is to be very largely used in the new East Sussex Asylum at Hellingly. The contract for the installation has just been placed with the firm of Messrs. J. E. Spagnoletti and Co. The generating plant is to consist of three 100-B.H.P. high speed enclosed engines, direct coupled to multipolar generators, giving out a pressure of 400 to 450 volts. The system of distribution is the three-wire, with 400 volts across the outers, with a 200-volt supply for the incandescent lighting and the small motors, and 400 volts for the large motors and the tramway line. There will be about 2,500 lights installed. At present 12 motors are being fixed in various parts of the building. A separate traction switchboard is to be supplied for controlling the tramline from the station to the asylum. The tramway is to be run on the overhead system. Trolley standards are to be fixed about every 40 yds. along the line of route, and these poles are to have brackets, to which the trolley wire carrying the current is to be fixed. A tramcar is to be supplied capable of seating 12 persons, and a locomotive is also to be supplied suitable for hauling trucks.

Eltham.—The Woolwich M.B.C. having now entered into possession of the Eltham portion of the Blackheath Company's E.L. undertaking, has decided to take current in bulk from the company, and to circularise the residents.

Failsworth.—The U.D.C. has decided that a committee is to wait upon the Electricity Committee of the Manchester Corporation and inquire on what terms they would be prepared to undertake a supply for Failsworth, now that their electricity scheme is more matured.

Falkirk.—Mr. Burstall, the consulting engineer, is to supply the Falkirk Town Council with the names of firms who are to be asked to send in approximate quotations and illustrations of lamp-posts for the lighting of the streets.

Abbots Foundry Company have applied to the Corporation re supply of electrical energy for their works.

Farnham.—The U.D.C. has received specification, estimates, and draft contract from the Edmundson Corporation for a complete scheme for lighting the district with electricity, but consideration is deferred pending negotiations with the gas company and the consideration of a suggestion to take current from the Aldershot U.D.C. in bulk.

Halifax.—Hipperholme Urban Council has decided to approach Halifax Town Council with a view to that body extending its electric light and tramway to the urban district.

Hanley.—With four dissentients, Hanley Town Council has decided to supply current for Coronation illuminations at 2d. per unit.

Lancaster.—The annual report as to the electrical department shows that for the second half of the year the price of current for motive power was reduced from 3½d. to 3d. per unit, and the charges for public lamps were also reduced from January 1st last. The total net profits were £931, as compared with £1,177 for the previous year. This sum has been carried to the reserve fund. The total sales of current increased by £494, and for meter rentals there was an increase, due to new conditions imposed upon small consumers, of £33. The income from public lamps decreased by £9. The total expenditure increased from £4,782 to £5,644; coal and insurance being the only items showing a decrease. The reserve fund now amounts to £2,131. The total capital, authorised and borrowed, is £35,000, and the amount expended is £39,346. The plant is now being extended so as to double the generating power, in view of the completion of the first portion of the tramway scheme, which should be in working order by a month or so.

Liverpool.—A L.G.B. inquiry is to be held regarding the City Council's application to borrow £300,000 for electricity supply extensions.

London.—CITY.—Last week the Court of Common Council decided to light the City School by electricity at £700.

ISLINGTON.—The B.C. has made application to the L.C.C. for sanction to borrow £2,100 for extending the electric lighting mains.

WOOLWICH.—The M.B.C. has resolved to apply to the L.C.C. for a loan of £101,000 to complete the purchase of the Woolwich District Electric Lighting Company's undertaking. The chief items scheduled are:—Purchase money, £79,700; capital expended in 1901, £8,961; ditto to May 31st last, £5,800; ditto pending (engineers' estimate), £6,874.

Londonderry.—At a meeting of the Corporation, held on the 11th inst., it was decided to engage Sir William Preece as consulting engineer, to give evidence at the inquiry, and carry out the scheme.

Mexborough.—The electric lighting scheme has been completed for £300 within the original estimate of £12,000, and the services of the electrical engineer (Mr. Waring) have been retained for a further three months.

Natal.—Messrs. J. L. Hulett & Sons are erecting a large sugar factory at the Umhlali; they will use electricity as a motive power, and the waters of the river Umvoti, a distance of four miles away, are to be utilised as part of the scheme.

Sheffield.—The E.L. Department reports a net profit of £5,604, compared with £6,294 in the previous 12 months.

Slough.—The U.C. has decided in favour of transferring the Slough Electric Lighting Order to the Windsor Electrical Installation Company.

South Shields.—At a meeting of the T.C. on the 11th inst, Alderman Rennoldson, in presenting the report of the Electric Lighting Committee, referred to the annual report of the electrical engineer (Mr. Cawthra). The report showed a profit of £2,111, and the causes of the balance falling short of what had been estimated were these:—The first quarter of the year was anticipated by some weeks, owing to the accounts of the previous quarter having been delayed, and thus overstepping the ensuing quarter; the reduction in the price of light had taken effect; there had been the cost of repairing damage done by an explosion in Commercial Road; and a new arc cable had had to be provided for King Street. Erroneous ideas had got abroad that these repairs were not paid for out of revenue. They had been and always were so paid. The items he had mentioned accounted for an extra expenditure of £1,190. On the other hand, they saved £500 on coal. Making allowance for the items of extra expenditure, the balance of £2,111 came very near to the estimate that had been made. During the present year they would have no outlay in regard to new plant or mains, all of which were now practically paid for. They had considerable surplus power, and he had reason to believe that next year would show a handsome profit. Mr. Henderson, in seconding, said that the cost of production was the lowest of any electricity supply works for lighting purposes only. In South Shields it was only 1·29d. per unit, which said a great deal for their undertaking.

Stafford.—The Council has approved the following amended scale of discounts to be allowed on accounts for electric current consumed per quarter:—Up to 140 B.T.U., 2½ per cent; between 140 and 700 B.T.U., 5 per cent.; between 700 and 1,400 B.T.U., 7½ per cent.; and above 1,400 B.T.U., 10 per cent.

The annual report of the electric lighting undertaking showed a deficit on the year's working of £1,157. The income was £2,955, an increase of £449, and the expenditure was £2,292, against £1,888; leaving a net revenue of £663 to be carried forward. Repayment of loan required £641, and interest £876. During the year the committee have had to relay all the cables in consequence of their having given way, and this had cost £2,000. Towards the cost of renewal the sum of £300 has been placed aside. The amount raised by loan for the undertaking was £30,000, and of this £27,967 has been expended up to the present time.

Sunderland.—The annual report of the Electricity and Lighting Committee shows that the number of lamps connected on March 31st last was 66,932, as compared with 50,092 for 1901, an increase of 34 per cent. The number of units sold was 2,375,557, as compared with 1,218,768 for 1901, an increase of 94 per cent. The number of consumers is now 721, as against 640 for 1901. The capital expenditure has been £205,082, and the revenue for the year £26,578; the costs being £15,212, a gross profit of £11,366, or 7·2 per cent. on the capital outlay, was left. After meeting interest and sinking fund, a net profit of £1,938 remained. The sinking fund now amounts to £13,613, or 11½ per cent. on the capital outlay. The deficit arising from the first three years of working has been wiped off, and a net balance is in hand of £1,346. The total station cost of production per unit was 1·53d., and the total cost, including sinking fund and interest, was 2·49d. per unit last year, the charge being 3d. The total production was 2,646,315 units; of this 1,413,405 units were consumed for lighting and 1,232,910 for traction. The report terminates with the hope that soon a scheme will be laid before the Council for supplying local shipyards and works with electricity, at a comparatively low cost, for motive power.

Surbiton.—The U.D.C. having sealed its contract with the Callender Company several members of the Council on Wednesday accepted the invitation to inspect the company's works.

Swansea.—The report of the first year's result of the electric lighting undertaking shows a gross profit of £2,163 4s. 1d., less interest £1,970 9s. 2d., leaving a net profit on the year's working of £292 14s. 11d. The debit balance on March, 1901, was £642 4s. 9d., and the deficit (excluding sinking fund for the present year) £349 9s. 11d. The units sold were 319,215, and the units sold per 8-C.P. lamp, 13·77. The average price obtained for private lighting was only 3·54d., and for public lighting 3·14d. Mr. Prusmann, in a lengthy analytical report to the committee, stated that in his opinion the result as compared with other towns, was very satisfactory. He trusted that the small loss would at the end of next year be turned into a profit. Power consumers, he noticed, were increasing largely. Had the price in Swansea to private consumers been the average, the loss of £349 would have been turned into a profit approximately of £552 towards paying off sinking fund, or in other words, the undertaking would practically be near paying all charges in its first year.

Trowbridge.—The claim of Mr. D. Stevenson for £214 4s. 9d. for advising Trowbridge Urban Council with respect to the proposed electric installation for the town has been settled by the payment of £200, all plans to be handed over to the Council. The Council have expressed their satisfaction at the manner in which Mr. Stevenson advised them.

Ware.—Mr. H. Wall Wilkinson has been instructed by the U.D.C. to prepare a report on electric lighting.

Yeovil.—The T.C., after considering the offer of Messrs. Crompton & Co. to apply for an electric lighting prov. order, has decided that the powers should be in its own hands rather than in those of a company. Consequently, it could not support Messrs. Crompton's application.

ELECTRIC TRACTION NOTES.

Barrow.—The T.C. on Tuesday last decided to lease the tramways to the B.E.T. Company. The company will take over the working of the present lines on a lease, substitute electricity for steam, and maintain a 15 minutes' service to the docks, Furness Abbey, and Roose, and commence the work of laying down the new trams within three months. The Corporation reserve the right to purchase at the end of every seven years.

Cardiff.—Two of the principal electric tram routes in the commercial and residential parts of the district—Cathays and Docks—were opened on Thursday, 12th inst. At a luncheon which followed, Mr. Ellis, the electrical engineer, in responding to a toast, said that at present they had only 40 out of 120 cars which were on order, so that he asked that critics should not expect the perfect service which would come when the cars were all in Cardiff. During the month of May they had carried a million and a half of people, and had taken in fares close upon £6,000, which was more than ample to pay the whole of the expenses, including interest and repayment of capital. With the continuance of that traffic they could do very well, but he confidently anticipated a handsome surplus when their system was in thorough working order with the complete service of cars.

France.—The conversion of the tramways at Lille to electric traction is almost complete, and the construction of several new lines is also in hand. The power station, which will eventually have a capacity of 3,600 H.P., is already equipped with a 1,200-H.P. steam dynamo, and one of 700-H.P.

Germany.—The last section of the Halle-Merseburg electric tramway—that between Ammendorf and Merseburg—has just been completed, and the whole line opened for traffic.

Huddersfield.—Major Druitt, on behalf the B. of T., on Tuesday last, inspected the Birkley, Almandbury, and Hanley routes of the Corporation.

Italy.—The project of constructing an electric railway between Rome and Naples has received the sanction of the commission appointed by the Minister of Public Works. The Rome terminus will be situated in the Place Cenci, and the station in Naples will be built in the Via dei Mille. The line will be 197 kilometres long, and the journey is to be accomplished in two hours. The railway will pass through Cisterna, Terracina, Formia, Mondragone, and Quaglino. The principal intermediary station will be Fondi. The line will be a double one, and can be traversed by the aid of either electric or steam traction. It will be used solely for passengers and mails.

Liverpool.—The electric car route over the two new approaches to the pier-head, Liverpool, was opened for traffic on Thursday last week. The route connects Water Street with the pier-head by means of the new roadway constructed across the site on the old George's Dock, so giving a straight-line approach from the main artery of Water Street.

Stalybridge, &c.—A deputation of the Stalybridge, Hyde, Mossley and Dukinfield Tramways and Electricity Board is to visit Hanley, London, Portsmouth, Southampton and Loughborough, for the purpose of inspecting various types of overhead equipment and cars.

Chatham and District.—Hitherto the Chatham district has been entirely dependent upon a miserably slow 'bus service, but on Tuesday, the 17th inst., the tram service of the Chatham and District Light Railway Company, Limited, was set in operation all through the district for a total length of traction more than 8½ miles. The system is worked by electricity, the cars running on a track of 3 ft. 6 in. gauge. The overhead trolley system is used. The construction of the permanent way has been in course of operation since the commencement of 1901. The rails are laid on a concrete foundation primarily, and then set in either "Janate" wood blocks or granite headers. The routes taken are from the large power house (situated at Luton), along the Luton Road to the east end of High Street, Chatham; from thence there are lines running up and down Chatham Hill on to the Rainham Road. Leaving the east end of Chatham, the trams run by way of the High Street and Brook, on to the new Town Hall. From this point passengers may take seats either to the C. & D. & S.E.R. station, and on to the Cemetery, or they may travel in an opposite direction to the various Barracks, Dockyard, School of Military Engineering, and many other Government establishments. In this direction also the trams will run on through Old Brompton, past the Royal Engineer Barracks and Gymnasium, over the Great Lines on to New Brompton. From this large dockyard, suburban trams can be taken to various parts of this district, and on to Gillingham Church, and up to "Jezreel's" tower, and here join the Chatham Hill section. There are at present 25 double-decked cars, which have been manufactured by Messrs. George F. Milne and Co., Limited. The cars are fitted with reversible garden seats for outside passengers, and with incandescent lights within and without. Some 50 persons can be accommodated on each car. The power station buildings at Luton include an immense car shed, power house, generating station, and the various offices required for the manager and his staff. The three largest engines are by Messrs. Yates & Thom, of Blackburn, and the boilers were made by the same firm. The smaller engines, for light work, are by Messrs. Belliss & Morcom. The electrical work has been carried out by the British Thomson-Houston Company, Limited, and Mr. F. Osmond (Southampton) has constructed the permanent way. Mr. C. H. Merz is consulting engineer to the company; Mr. W. Jensen (formerly of Croydon) resident engineer and manager; and Mr. Gordon Davies, traffic manager. The whole of the line and works having been previously passed by the Board of Trade, the formal opening of the tramways service began on Tuesday last with an assemblage at noon at the Luton power station of a representative gathering of gentlemen invited by the chairman and directors of the company. The party numbered some 150 gentlemen, including the Mayor of Chatham (Mr. H. J. T. Browne) and the aldermen and councillors of the borough, with the town clerk and officials, the Mayor of Rochester (Councillor Chas. Tuff) and aldermen and councillors of the Rochester Corporation, with town clerk and officials. The gentlemen associated with the company assembled included Mr. A. R. Monks (chairman of the company), Mr. S. G. Fraser (brother to General Sir Thomas Fraser, K.C.B., C.M.G. in Command of the Chatham Garrison and Thames District), with whom is associated Mr. A. H. Walton, as the engineer to the company; Mr. E. T. James (representing the British Thomson-Houston Company, Limited); Mr. C. H. Merz (of London and Newcastle), consulting electrical engineer; Mr. W. Jansen, the resident engineer and manager; Mr. W. Gordon Davies, traffic manager; &c.

Having inspected the company's splendid plant and general works thoroughly, the unanimous opinion seemed to be that the company have spared no pains or money in starting the affair on a good sound practical line. The party then entered the cars awaiting them and proceeded direct to the Town Hall by way of Luton Road and High Street. At the Town Hall luncheon was served, after which the Chairman first submitted "The King," and after a verse of the National Anthem, "Her Majesty the Queen" was the next toast given loyally from the chair, associated with that of the Prince and Princess of Wales and the rest of the Royal Family.

"The Corporations of Chatham and Rochester, and the Gillingham District Council," was next given by the chairman, who expressed the hope that the prosperity which already prevailed at Chatham and Gillingham would be increased by the introduction of the tramways system, bringing as it would to the towns a quick and cheap service. The company had spent a considerable amount of money, and would continue to expend it, in the introduction of their trams, and, as they had seen that day, they had a power station and plant on the most improved system, and capable of further development; they had laid down a large track, and he hoped the whole tramway system would redound to the credit of the company and the local governing bodies. He desired on behalf of the company to thank the Corporation of Chatham and the Gillingham District Council for the courteous manner with which they had received the company throughout. He knew there was unfortunately sometimes a little friction between municipal corporations and private enterprise, but in this case they had been quite free from that. If the local authorities would support the company in the future as they had done in the past, he should be satisfied. He should like to thank the Mayor of Chatham for his kindness in placing that hall at the disposal of the company. With the toast he coupled the names of the Mayors of Chatham and Rochester, and the chairman of the Gillingham District Council, who all responded.

The Mayor of Chatham gave "Success to the Chatham and District Light Railway Company."

The name of Mr. Monks, the chairman, was associated with this toast, which was well received. Mr. Monks, on behalf of the company, thanked the proposer for the kind way in which he had given it, and the company for the cordial reception of the toast. Of course, as business men their first duty was towards the shareholders who had embarked in this undertaking, but this did not prevent them from promoting the welfare of the public. The chairman then spoke in high terms of the British Thomson-Houston Company, who supplied the electrical equipment, and the good track laid down by Mr. Osmond. Messrs. West Bros. had built a good depôt, and they were fortunate in securing the best engineering skill in Mr. Fraser and Mr. A. H. Walton. The chairman also said they had the able services of Mr. C. H. Merz, and he hoped the Corporation of Chatham would extend to him and his staff the same courtesy and help in the future as they had done in the past.

Mr. Fraser gave "The Visitors," and the Mayor of Gravesend, the High Constable of Gillingham and Mr. Vaughan (of Maidstone) replied to the toast, and shortly afterwards the pleasant gathering broke up.

The trams will now run at frequent intervals on very low fares. The whole distance can be traversed for 2d., the other journeys between being done at 1d. and 1½d.

Gloucester.—There is now very little probability of the dispute between the Gloucester Corporation and the County Council being amicably settled. Representatives of both authorities have met in conference, but the attempt at settlement has failed, and the matter of the proposed electric tramways will have to be fought out before the Commissioners. Mr. Nevins intends to spend some £300,000 upon his scheme for Stroud, connecting that town with Gloucester and Cheltenham. The piece of road which is claimed or the scheme proposed by the Corporation, and over which Mr. Nevins also desires that his trams should run is a very small matter, after all, but the Commissioners will have to deal with a mass of evidence from both sides at the inquiry which is expected to be held early in August. Representative bodies in Gloucester and Stroud have already appointed their witnesses, and the result will be awaited with the keenest interest.

Manchester.—The electric trams are proving a great success. For the week ending June 7th, the traffic reached a total of 1,122,184 passengers.

Paris.—The third portion of the northern circle of the Metropolitan Railway was inspected last week by M. Bienvenu, chief engineer of the City of Paris. It extends from the Chaussée Clignancourt to the Boulevard Magenta, and it is precisely similar in construction to the portion already completed. There are three stations: Square d'Anvers, Place Pigalle, and Place Blanche. The line is being constructed in a fairly rapid manner, and the company hopes to open the portion from the Etoile to the Boulevard Magenta at the end of July, and the whole line to the Place de la Nation in December. The cost of construction of each kilometre is 4,500,000 francs. According to M. Garetta, director of the company, it will be seven years before the whole of the Metropolitan system will be completed. M. Bienvenu has been to America to study the system of work carried out there, and he says that if Parisians saw the trenches opened out in New York, they would be much gratified by the small amount of inconvenience caused by the excavations in Paris.

Sunderland.—The first annual report of the Tramways Committee shows that the result of the year's working is that a net profit of £7,742 is left after meeting all charges. The income for the year was £57,307, and the expenditure £49,565. Included in this last item were the working expenses, £30,719. Of this last figure electrical energy cost £10,274; wages, £13,654; salaries, £637; oil, salt, lighting, £976; rent, rates, and taxes, £1,378; printing, tickets, uniforms, &c., £1,696; compensation to third parties, £173; insurance, £82; repairs and maintenance of rolling stock, £794; repairs and maintenance of permanent way, £745; repairs and maintenance of electrical equipment, £226; repairs and maintenance of buildings, £80; interest and depreciation represented £18,846, the amount transferred to the depreciation fund being £12,159. The car-miles travelled were 1,170,207, the units of electricity consumed were 1,232,910, the units consumed per car-mile being 1·05, and the passengers carried 13,596,808. The income per car-mile was 11·75d., and the total expenses per car-mile were 10·16d., leaving a net profit of 1·59d. per car-mile. The The capital account shows an expenditure of £223,540. The percentage of gross profits on this sum was 11·89, and the net profit worked out to 3·46 per cent. on the capital expended. The sum carried to the revenue account was £26,588 13s. 4d.; the balance from last year was £1,757 12s. 10d., making a total of £31,346 6s. 2d., and this is disposed of in the following way:—Interest on mortgage debt, £6,687 2s. 4d.; amount transferred to compensation accident fund, £500; depreciation fund, £12,159 3s. 10d.; reserve fund, £5,000; balance carried forward in aid of the borough rates, £7,000. The sinking fund account shows that £6,700 of principal has been repaid.

Wolverhampton.—An interesting discussion on the Lorain system of traction took place on Saturday at a conference of municipal and county engineers from all parts of the country, held in the Assembly Room of the Drill Hall, Wolverhampton. Two papers dealing with the system were read by Mr. Geo. Green, borough engineer of Wolverhampton, and Mr. C. E. Shawfield, borough electrical engineer. The discussion which followed elicited several new and important facts. It was stated that the cost of making and electrically equipping the 23½ miles of single track embraced in the Wolverhampton tramway scheme would be £210,000.

Mr. Price (Birmingham) asked what the difference in price was

between that and the overhead system for the same length? Then, again, the passing of heavily-weighted lorries and wagons over the different lines of boxes must, he (Mr. Price) should consider, tend to loosen them out of place, or cause depressions in the stone setts or wood pavement, resulting in the admission of wet and damp, and then trouble.

Mr. Eayrs (Birmingham) called attention to the unevenness of some of the Lorain boxes, projecting, as they did, at different heights in some places above the level surface of the track, and remarked that they must be the cause of some annoyance to drivers of vehicles. Was this unevenness caused by bad laying of the track, or was it in consequence of the track being laid before the Lorain boxes were put in? Next, was there not greater danger of leakage of the electric current from this system than from the overhead trolley? There was no mention in either of the papers as to how long the magnetic skid or skate that was fixed along the bottom of the cars was likely to last. Speaking without experience, he should think the continuous grinding every 12 ft. of this skid over the tops of the Lorain boxes must cause a tremendous amount of wear. Two other questions he should like to ask were:—(1) What was the average cost of working per car-mile; and (2) whether the granite (reconstructed granite) boxes could not be as well made in this country as in America?

Mr. Wilkinson (Harrogate) wished to know what had been the experience, since the cars commenced running, of moisture percolating into the boxes; and, next, whether any accidents had occurred through boxes remaining "alive" after the cars had passed over them?

Mr. Green, in reply, said as to the cost of laying down the system in Wolverhampton, the estimated amount when the entire scheme had been carried out, was £210,000. That included the car shed, depôt, &c. At present they had got between 11 and 12 miles single line laid down and equipped out of the total length of 23½ miles. The actual cost of laying down the track was £5,500 per single line mile. That included the breaking up in the first instance of the macadamised road, the carting away of the material, the formation of the track, and laying down the rails, but did not include the cost of equipment. So far as they had had experience, no complaint had been received of any annoyance to drivers or owners of vehicles by driving over the tracks; neither had any of the boxes been injured by heavy traffic. On this point, just before Christmas last they put the boxes on the mile track to a most severe test by causing to be run over them a traction engine drawing two trucks loaded with a heavy boiler, the total weight being between 35 and 40 tons. On examination afterwards none of the contact boxes were found to have been injured by the passage over them of this heavy weight. With regard to the unevenness of some of the boxes in projecting above the wood pavement, it was more apparent than real. In reply to the question put by Mr. Eayrs with respect to the Lorain boxes, the reconstructed granite of which they were composed was considered the hardest material that could be produced for their manufacture in America. But he was by no means satisfied with them. Some of them that had been laid down from the commencement showed practically no wear whatever, whilst others had to be replaced after a few weeks' working. He was in hopes of being able to find some kind of material in some part of England that would be of a harder and more durable character.

Mr. Shawfield also replied with regard to the granite boxes. He said he agreed with Mr. Green that it was too early at present to give a satisfactory answer to the question as to how long they would last. Some of them would, in all probability be worn out and have to be replaced long before the end of the first 12 months, whilst others would show but little signs of wear. Water had found its way into some of the boxes, the cause in each case being the same, viz., the fracture of the boxes. This was due to the fact that a man who was engaged to assist in screwing them up, being of the navvy type, with more muscle than brains, exerted such an amount of force that he fractured nearly all the boxes on which he operated. This was not found out at the time until after the wet had percolated into the boxes, and so caused contact. The result was that some 50 of these boxes were found "alive" at different times, to the extent of from 300 to 520 volts. This had led to a few horses stumbling down at different times, but beyond being a little surprised at what had occurred, none of them were any the worse. With respect to the life of the skate beneath the cars, at first, owing to the great friction that occurred, it was estimated they would not last longer than about 1,000 miles' run. Since then, however, several improvements had been introduced, particularly in putting the paving in different parts between the sides of the track in better condition, so that it was now estimated that a skate would not require renewing more frequently than at the termination of each 3,000 car-miles run. Up to the present the total miles run was about 30,000, but he was not in a position to give any estimate as to the working cost per mile, until he had had a little longer experience of it. Mr. Shawfield also stated that the cost of equipping the tracks after the rails had been laid down was about £1,800 per single line-mile. The total cost—including formation and equipment of the track—was about £500 per single mile more than the overhead system.

In our last issue an error occurred in the paragraph under the head "Wolverhampton." One sentence is there made to commence, "General Manliers felt that if the engineer were allowed to interfere with the cars or the skates during the test," &c. This should have read, "*Several members* felt that if the engineer were allowed to interfere with the cars or the skates during the test," &c.

Woolwich.—The M.B.C. has decided to pay one-third of the cost of widening Mill Lane for tramway purposes, but has informed the L.C.C. that the estimate of £7,600 for the work is considered high.

TELEGRAPH AND TELEPHONE NOTES.

French Cable Cut.—A Central News telegram states that it has transpired that the French company's cable was wilfully cut recently at a point two miles south of Coney Island. There is no clue to the perpetrators of the outrage. The company have offered a reward of £100 for their detection.

Glasgow Telephones.—To celebrate the completion of the British Insulated Wire Company's contract for the installation of the Glasgow Corporation telephone department's underground work, the company's resident superintendent, Mr. A. C. Devey, has been presented with a handsome silver cigarette case by the chief members of the telephone department. On the same occasion, Mr. J. C. Jones, assistant superintendent, on behalf of the company's local staff and workmen, presented Mr. Devey with a pair of statuettes and a silver cruet as a souvenir of the cordial relations existing between them. The work just completed comprises 100 miles of underground 3-in. cast-iron pipes, and about 150 miles of cable equivalent to approximately 30,000 miles of single wire; this is the second largest underground telephone system in the world, the Post Office system in London taking the first place. Glasgow can, however, claim to have installed the largest telephone cable ever made; this cable being too large to go into the 3-in. pipes, is accommodated in a 6-in. pipe.

Telephones in Italy.—A project of law has been deposited in the Italian Chamber by a number of deputies for the extension of telephonic communication between various Italian towns. The Bill comprises two sections or projects, each of which it is proposed to carry out in two successive periods of four years, at a total outlay of 5,800,000 lire. Facilities are to be given to private enterprise to carry out certain portions of the proposed works to be afterwards taken off by the Government.

Mexico.—The Federal Government has purchased the telegraph system of the State of Jalisco.

The P.O. Telephones.—The Secretary to the Treasury announces, says the *Times*, that about 1,650 telephones are now working in connection with the new Central Exchange in Queen Victoria Street, which was opened for service on February 24th. In the Fleet Street and Strand districts the main cables for subscribers' lines were laid and completed some time ago; but, in order to avoid unnecessarily opening the footways in the busiest thoroughfares, arrangements have had to be made to transfer the telegraph wires in the existing pipes under the pavement to other routes so as to make these pipes available for the distribution of telephone wires. This work is of a difficult and complicated nature, but it is hoped that it will be completed along Fleet Street and the Strand in the course of three weeks or a month. As soon as this has been done the task of connecting the premises of subscribers in the Strand district with the main lines of telephone wires will proceed very rapidly.

Telegraphic Interruptions and Repairs:—

Cables.	Interrupted.	Repaired.
Latakia-Cyprus	June 20, 1899	
Puerto Plata-Martinique	May 30, 1902	
Trinidad-Demerara No. 1	Aug. 27, 1901	
St. Lucia-Martinique	May 7, 1902	
St. Lucia-St. Vincent	May 7, 1902	
St. Lucia-Grenada	May 7, 1902	
Dominica-Martinique	May 5, 1902	
Guadeloupe-Martinique	May 5, 1902	
Djedda-Souakim	June 18, 1902	
Landlines:		
Route *via* Hanekin on Persian territory	Feb. 24, 1900	
Communication with Tientsin and Taku *via* Helampo	June 18, 1900	
San Domingo landlines	June 11, 1902	
Jask-Karachi	June 18, 1902	
Omara-Karachi	June 18, 1902	

Wireless Telegraphy.—A company has been formed at Madrid, under the title of Sociedad Anónima Espanole de Telegrafia y Telefonia sin hilos (Spanish Wireless Telegraph and Telephone Company, Limited), by the Commandant Cervera, with the object of constructing wireless telegraph and telephone instruments of the Cervera system in Spain. Consejo D. Antonio López Munoz is the president of the new company.

A Halifax telegram to a Leeds paper says that the work of erecting the Marconi wireless telegraph station at Tablehead, Cape Breton, has now been completed, and the apparatus installed ready for the proposed trans-Atlantic experiments. The signal towers are 215 ft. high.

Some experiments with wireless telegraphy are about to be carried out by the Spanish telegraph authorities between Cape Nao (province of Alicante) and Cape Pelado, on the Island of Iriza in the Mediterranean Sea.

According to the *Daily Mail*, wireless telegraphy is to be used on Italian railways as a means of preventing accidents.

Fatality.—A master plumber, when standing at the top of a ladder about 9 ft. from the ground, putting up a gas pipe in the Mannofield tramcar depôt at Aberdeen, brought his hand into contact with a "live" wire, receiving so severe a shock that he fell to the ground; he was so injured about the head that he died in the Royal Infirmary.

CONTRACTS OPEN AND CLOSED.

OPEN.

Austria.—September 1st. The municipal authorities of Klausenburg (Kolozsvar), Siebenbürgen, are inviting tenders until September 1st, for the establishment in the town of a central station for electric lighting and power purposes. Tenders are to be sent to Bela Fekete Nagz, Kolozsvar, from whom particulars may be obtained.

Bootle.—June 20th. The School Board wants tenders for the installation of electric light in the Bedford Road Board School, Bootle. Specification, &c., from Mr. F. K. Wilson, clerk.

Bournemouth.—June 23rd. Station and car depôt lighting and wiring motors, also testing instruments and accessories for the Corporation tramways. See "Official Notices" June 13th.

Bristol.—June 20th. Pumps, water softener, filters and pipework for the electricity department. See "Official Notices" June 6th.

Bury.—June 24th. Construction of permanent way for tramways. Particulars from Mr. A. W. Bradley, borough engineer and surveyor.

Chili.—The Chilian Government proposes to construct a cable connecting Punta-Arenas and Puerto-Montt. Particulars concerning the proposed undertaking can be had by those interested from the Chilian legations in the various capitals.

Epsom.—July 18th. Semi-marine dry-back boiler, condensers, pumps, cooling pond, piping, one 150-KW. steam dynamo, switchgear, &c, for electricity works extensions. See "Official Notices" to-day.

Falkirk.—July 14th. Pumps, balancing transformers and motor-generators, storage batteries, switchboard, arc and incandescent lamps, cable work, and travelling crane. See "Official Notices" to-day.

Gillingham.—Water-tube boilers, piping, condenser, cooling tower, high-speed engines and 250-KW. three-phase alternators, switchboard, cables, arc lamps, crane and well, for the U.D.C. See "Official Notices" to-day.

Hungary.—September 1st. The authorities of Kolozsvár, in Hungary, want to introduce electricity for lighting and power purposes. See "Official Notices" May 9th.

Ipswich.—July 5th. Engines and dynamos, storage battery, overhead hand travelling crane, feeders, mains, &c., permanent way construction, and arc lamps. See "Official Notices" June 6th.

Launceston (TASMANIA).—September 15th. The Corporation wants tenders for polyphase generating, transmitting, transforming and distributing apparatus, reconstructing existing plant, enclosed arc lamps, &c. See "Official Notices" May 23rd.

Little Woolton.—June 20th. Laying and jointing of cables, supply and fixing of junction boxes and lamp connections, and supply of lamp fittings. See "Official Notices" June 6th.

London, S.W.—July 31st. The War Office wants tenders for a self-propelled lorry (oil). See "Official Notices" April 25th.

Manchester.—July 1st. The Electricity Committee invites tenders for stores, including incandescent lamps, &c.

Nuneaton and Chilvers Coton.—June 30th. Cables, joint boxes and compounds; also arc and incandescent lamps, columns, switches, &c., for the U.D.C. See "Official Notices" to-day.

Queensland.—July 28th. Tenders will be received at the office of the Deputy Postmaster-General, Brisbane, till July 28th, for the supply of telephone cable and switchboards as follows:—(1) Two miles 104 pair cable to specification No. 6; (2) Five miles 52 pair cable to specification No. 6; (3) Two miles 39 pair cable to specification No. 6; (4) Two miles 26 pair cable to specification No. 6; (5) One mile 13 pair cable to specification No. 6; (6) Two miles 26 conductor to specification No. 7; (7) Five metallic circuit telephone switchboards (100 lines) to specification No. 8. Specifications can *only* be seen, and forms of tender obtained, at the General Post Offices, Sydney, Melbourne, Brisbane, Adelaide, Perth and Hobart.

Romford.—June 30th. The U.D.C. wants offers for the construction and maintenance of electricity supply works. See "Official Notices" June 13th.

Servia.—July 1st. Tenders are being invited until July 1st by the Société d'Electricité de Leskovatz (Servia) for the supply and erection of two 200-H.P. turbines, two three-phase alternating dynamos of similar capacity, and the necessary accessories for the transmission of the power generated to Leskovatz, a distance of 10½ miles. Tenders are to be sent to Le Conseil d'Administration de la Société d'Electricité, Leskovatz, Servia, whence particulars may be obtained.

Spain.—June 30th. Tenders are being invited until the 30th inst. by the Spanish Ministry of Agriculture, Industry and Commerce, for the supply of the necessary apparatus required at the station for testing and verifying electricity meters about to be established.

Stalybridge.—July 7th. Three 500-KW. steam-driven three-phase alternators; three 50-KW. continuous current exciters; permanent way, bonding and cable conduits for the Stalybridge, Hyde, Mossley, and Dukinfield Tramways and Electricity Board. See "Official Notices" June 13th.

Stockport.—June 24th. The Gas and Electricity Committee invite tenders for stores, including brass and meter fittings.

Sunderland.—At the meeting of the T.C. on the 11th inst., it was resolved to purchase an electric locomotive at an estimated cost of £460.

Sunderland.—July 10th. Permanent way, overhead equipment and cables for the Corporation tramways department. See "Official Notices" June 13th.

Sydney.—July 23rd. Complete system of high and low pressure cables, and of arc lamps for street lighting, for the Municipal Council. See "Official Notices" June 13th.

Valparaiso.—September 1st. Construction and equipment of electric tramways. Further particulars from the Chilian Consulate.

Wellington (Salop).—June 25th. The U.D.C. invites applications for a lease of its electric lighting powers. See "Official Notices" June 6th.

West Ham.—50 double-deck electric cars with equipments, for the Council. See "Official Notices" June 6th.

CLOSED.

Barrow-in-Furness.—The tender of Messrs. Veritys, Limited, for arc lamps and posts for Vickerstown for the Corporation has been accepted.

Bedford.—The T.C. has accepted the tender of Messrs. Green & Sons for the supply of two economisers at the electric light works at £850.

Burton.—The T.C. has accepted the tender of the B.T.H. Company for three 100-KW. high-speed tramway generators and switchboard for the sum of £4,099. For three Lancashire boilers, steam pipes, jet condensing plant, economiser, &c., the tender of Messrs. Clayton, Son & Co., has been accepted, subject to certain conditions.

Dartford.—The U.C. has accepted the following tenders for extensions to the electric lighting plant:—Messrs. Reavell and Co., Limited, for one steam dynamo with the necessary steam and exhaust piping and extensions to the switchboard, £2,248 10s.; Messrs. J. Carter & Son, Atlas Works, Stalybridge, for a Lancashire boiler with feed pump, and extensions to economiser and feed pipes, £860 8s.

Hackney.—A number of tenders for boilers and water-softening plant have been before the Electricity Committee, and that of Messrs. Babcock & Wilcox, amounting to £8,030, is recommended to the Council for acceptance.

London.—The London County Council received the following tenders for the supply of a battery for the Horniman Museum:—

Pritchetts & Gold (accepted)	£66
Chloride Electrical Storage Syndicate..	78
Electrical Power Storage Company	76
Drake & Gorham	83

WOOLWICH.—The B.C. has accepted the tender of Messrs. T. Harding Churton & Co., for a 70-B.H.P. enclosed motor for driving machinery in connection with the refuse destructor.

Manchester.—The Tramways Committee of the Manchester Corporation have just placed an order for 34,000 copper railbonds with Messrs. Robert W. Blackwell & Co., Limited. These bonds are of the well-known "Crown" and "Chicago" types. This order, taken in conjunction with an order placed by the Manchester Corporation last year for 50,000 railbonds, constitutes, we should think, a record for railbond orders in this country.

Natal.—The Natal-Durban Railway has accepted the tender of Messrs. D. Bruce Peebles & Co. for electrical generating plant for the Government railway shops to the value of £8,371.

Sculcoates.—The Board of Guardians having decided to have an electric light installation in the workhouse, have accepted the tender of the Hart Accumulator Company, Limited, for the supply of accumulators (£581), and that of Messrs. G. Wokes and Co. for switch gear (£105).

Sheffield.—We understand that Arc Lamps, Limited, have just received a large order from the London and North-Western Railway Company for W. J. Davy arc lamps for lighting their Sheffield station. This is the second large station in Sheffield that will be lit by these lamps.

St. Helens.—Messrs. Veritys, Limited, have been awarded the tender for the new power and feeder panels for the Corporation switchboard.

Woolwich.—On 12th inst. the M.B.C. accepted the third of the following tenders for a 70-B.H.P. motor for driving the flag-making plant at the Council's Plumstead electricity station. The last tender on the list was the lowest, but the electrical engineer having reported on the work of both firms, recommended the former as more suitable. The details were:—

No.	Name of firm tendering.	Wages clauses.	Total with spare armature, omitting coils.	Total with spare coils, omitting armature.	Delivery.	Remarks.
			£ s. d.	£ s. d.		
1	Mather & Platt, Limited, Manchester	Pay recognised wages in district	349 5 0	264 15 0	2 months	Two-bearing machine
2	Holmes & McCallum, Darwen	" "	340 0 0	283 8 0	2 "	£15 extra for three bearings
3	T. H. Churton & Co., Leeds (accepted)	" "	315 8 0	228 8 0	2 "	£10 " "
4	W. B. Haigh & Co., Limited, Oldham	Not referred to	366 0 0	298 4 0	2½ "	
5	Phœnix Dynamo Manufacturing Co., Bradford	"	550 0 0	426 10 0	3 "	
6	Siemens Bros. & Co., Limited, Woolwich	Pay recognised wages in district	494 1 0	386 0 0	3½ "	
7	D. Bruce Peebles & Co., Edinburgh	Not referred to	—	431 0 0	2 "	
8	General Electric Company, London	"	588 7 6	441 0 0	3½ "	
9	Reed's Electrical Engineering Company, London	"	411 18 8	343 5 9	5 "	
10	Lancashire Dynamo and Motor Co., Manchester	"	529 0 0	410 0 0	3 "	
11	Paterson, Cooper & Co., Paisley	"	468 5 0	373 1 0	3 "	
12	F. Suter & Co., Limited, London	Rates of wages will be observed	366 4 6	276 18 6	4 "	
13	Lahmeyer Electrical Company, London	Not referred to	489 0 0	354 15 0	—	Form of tender not filled in
14	Mavor & Coulson, Glasgow	Standard rate of district	410 0 0	314 0 0	3 "	
15	Dick, Kerr & Co., Limited, London	Not referred to	—	251 5 0	2 "	
16	Morley Electrical Engineering Company, Morley	Standard rate of district	427 10 0	312 10 0	3 "	
17	Electrical Company, Limited, London	" "	366 5 0	244 5 0	2 "	Alternative — Liquid starter £.0 10s. less.
18	Veritys, Limited, London	" "	414 0 0	—	5 "	
19	International Electrical Company, London	Not referred to	492 7 0	—	5 "	
20	Imperial Electric Supplies, Limited, London	"	602 12 6	510 0 0	3 "	
21	Johnson & Phillips, Charlton	Standard rate of district	425 0 0	313 0 0	2½ "	Prices do not include necessar connections.
22	Crompton & Co., Limited, London	— —	791 0 0	—	6 "	Wages clauses entirely deleted
23	Witting Bros., London	Standard rate of district	631 10 0	463 12 0	4 "	
24	British Westinghouse Company, London	Not referred to	—	297 10 0	4 "	
25	Rosling & Fynn, Bradford	"	583 0 0	476 10 0	2½ "	
26	British Thomson-Houston Company, Rugby	"	—	269 8 6	2½ "	
27	Newton Electrical Works, Taunton	"	353 5 0	—	—	
28	Geipel & Lange, London	"	544 7 6	397 7 6	—	
29	International Electrical Engineering Co., London	Standard rate of district	348 10 0	314 0 0	2 "	£15 extra for three bearings.
30	R. Woods & Co., London	" "	447 19 0	346 18 0	3 "	
31	Royce, Limited, Manchester	" "	364 5 0	—	3 "	
32	Bergtheil & Young, London	" "	377 9 6	—	2 "	
33	Lister Electrical Manufacturing Co., Dursley	Not referred to	475 0 0	355 0 0	3 "	
34	H. V. Kramer & Co., London	Standard rate of district	343 0 0	273 0 0	3 "	£16 10s. extra for 3 bearings.
35	P. R. Jackson & Co., Manchester	Not referred to	652 0 0	489 10 0	3 "	
36	J. P. Hall & Co., Oldham	" "	468 10 0	354 10 0	4 "	
37	Electric Construction Company, Wolverhampton	"	794 10 0	—	3 "	
38	British Schuckert Electric Company, London	Standard rate of district	420 15 0	323 15 0	3 "	
39	Greenwood & Batley, Leeds	Not referred to	347 2 6	280 14 6	3 "	
40	C. R. Heap, London	" "	523 12 0	436 2 0	2½ "	
41	Cutting Bros., Derby	" "	251 3 0	197 13 0	2 "	

The Council also accepted the tender of Mr. Oscar Scholzig for 10,000 pairs of arc carbons, for which 24 firms tendered as follows:—

No.	Name of firm.	Wages clauses.	Price per 1,000 pairs.	Price for the whole amount, viz., 10,000 pairs.	Delivery.	Make.	Remarks.
			£ s. d.	£ s. d.			
1	Geipel & Lange, London	Not referred to	6 0 0	60 0 0	6 weeks	Not stated	Commence delivery at once.
2	Imperial Electric Supplies, Limited, London	Conform with same	7 0 0	70 0 0	2 months	"	
3	Johnson & Phillips, Charlton	Carbons made in France	5 17 6	58 15 0	2 "	Conradty's	Will not be responsible for breakages.
4	R. Woods & Co., London	"	6 3 0	61 10 0	2 "	Henrion	One month delivery, if necessary.
5	Brush Electrical Engineering Co., London	Conform with same	4 17 11	48 19 2	1 "	Brush	
6	Veritys, Limited, London	"	4 18 0	49 0 0	6 weeks		
7	V. Dasnieres	Made in France	5 15 0	57 10 0	Few months as required	Not stated	
8	Improved Electric Glow Lamp Co., London	Conform with same	19 5 6	192 15 0	Not stated		
9	The British Thomson-Houston Co., Limited London	"	5 5 0	52 10 0	6 weeks	—	Less 2½ per cent. for cash in a month.
10	Crompton & Co., Limited, London	Made in Bavaria	4 13 9	46 17 6	As required		
11	Sloan Electrical Company, London	Conform with same	5 4 0	52 0 0	1 week		
12	General Electric Company, London	"	4 15 0	47 10 0	From stock		
13	Krupka & Jacoby, London	"	5 10 0	55 0 0	2 months		
14	International Electrical Engineering Co., Ltd.	"	6 4 6	62 5 0	3 "		
15	Siemens Bros. & Co., Limited, Woolwich	Made in Germany	16 0 0 a 8 17 6 b	160 0 0 88 15 0	3 "	—	Alternative tender. Burning hours given.
16	G. Braulik, London	Conform with same	5 9 3	54 12 6	8 "		
17	English Electric Carbon Company, Brymbo	"	5 6 0	56 0 0	1 "		
18	Cryselco, Limited, Bedford	"	10 1 9	100 17 6	6 weeks		
19	International Electric Company, London	"	4 19 0	49 10 0	2 "		
20	Oscar Scholzig, London (accepted)	Made abroad	4 8 9	44 7 6	In one lot, 4 to 5 weeks		
21	Atkinson & Schmahl, Newcastle-on-Tyne	Conform with same	6 1 6	60 15 0	1 month		
22	Oliver & Co., Woolwich	"	4 16 0 8 8 0	48 0 0 84 0 0	1 "	—	Alternative tender.
23	DeGrelle, Houdret & Co., London	"	4 11 6	45 15 0	3 days		
24	Witting Bros., London	"	4 13 6	46 15 0	3 "		

Walsall.—The T.C. has accepted the tender of Messrs. Babcock & Wilcox, Limited, for a water-tube boiler, &c., for the electric light works, at £1,080, and that of the Electrical Power Storage Company, Limited, for a battery of accumulators, at £1,117.

Cauvery Falls Power Scheme.—A Madras paper says that the new electrical power distribution works on the Kolar Gold Field were to start operating on June 1st.

NOTES.

Next Week's Issue of the "Electrical Review."—May we again draw the attention of all our friends to the fact that the Electrical Review for Coronation week will be published next Wednesday morning instead of Friday. The latest time for receiving matter for the editorial pages is 5 p.m. on Monday. New copy and alterations to existing displayed advertisements must be in possession of the advertisement manager by Saturday morning, the 21st. Official Notices and small pre-paid advertisements can be received up to Tuesday morning, the 24th.

Appointments Vacant.—A number of men are wanted for the Gravesend electricity station; an assistant engineer for Watford; and an improver for Barrow-in-Furness; a shift engineer is required at Hull at £78; five assistant superintendents in the Indian Telegraph Department (for slightly altered conditions see "Official Notices" to-day).

Coventry Electric Lighting.—The City Council on Tuesday decided to dispose of the No. 1 plant at the electric light works which has become too small and useless; its place is to be taken by more up-to-date plant.

(*Continued on page* 1027.)

THE NEW ELECTRICITY WORKS OF THE METROPOLITAN BOROUGH OF SHOREDITCH.

When the existing electric power station of the Shoreditch Borough Council was opened by Lord Kelvin, in June, 1897, it contained three generators, each of 165 kw., and three with an output of 70 kw. each, and it was supposed that this plant would be quite sufficient to supply the electrical requirements of Shoreditch for many years to come. From the moment, however, that the service was inaugurated, the demand has steadily increased, and though for some time past the original generators have been supplemented by others of the largest size that could be got into the remaining space in the original engine room, it recently became necessary for the Council to seriously consider the advisability of erecting a new power station, on a larger scale than the former one.

A suitable site having been found on the banks of the Regent's Canal, the Borough Council instructed their consulting electrical engineers, Messrs. Kincaid, Waller and Manville, to prepare a comprehensive scheme for the erection of a new power station which should provide for all the possible future needs of the district. The scheme proposed by them was adopted by the Council, and the works, of which the following is a description, have been completed under the supervision of Messrs. Kincaid, Waller & Manville, and Mr. C. Newton Russell, the borough electrical engineer.

The design of the new power station, as will be seen by the description, is on a large scale, although only 2 units of generating plant have at present been installed; but the engine house and boiler house are capable of extension as may be necessary. The plan and elevation show the general arrangement of the works.

Buildings.

The generating station occupies a site of about 19,800 super. ft. in area at the corner of Whiston Street and Bath Place, Haggerston, with frontages to the Regent's Canal and the Haggerston basin, enabling coal to be delivered by barge and providing a supply of condensing water.

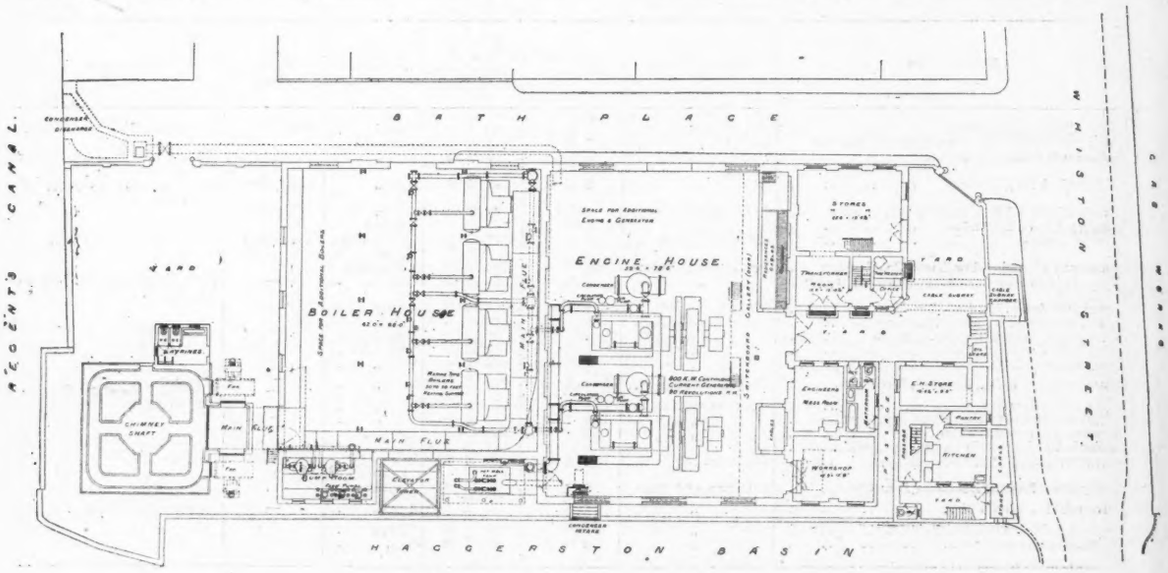
Cross-Sectional Elevation of Generating Station.

The main buildings consist of a boiler house 68 ft. by 62 ft., with pump room adjoining, and engine house 78 ft. 6 in. by 59 ft. 6 in., with basement, into which the condensing water and other pipes are taken. A subway, leading from this basement to a chamber under the pavement in Whiston Street, is provided for the feeder cables leaving the station.

A transformer room containing the continuous current transformers for supplying the network in the neighbourhood of the generating station, together with workshop and stores, adjoins the engine room.

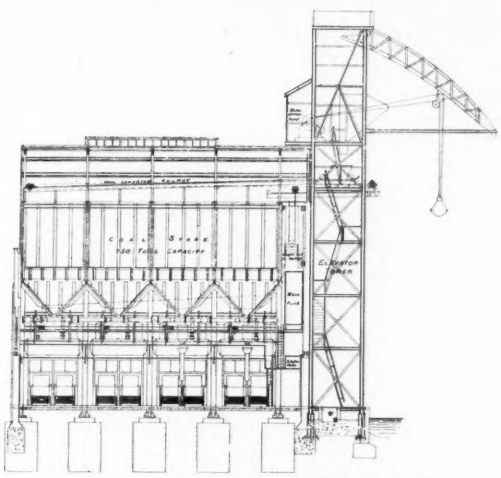
The switchboard gallery extends the whole length of the engine house, at a height of 11 ft. above the floor level. Chambers are provided below the gallery for the reception of the shunt-regulating and other resistances, and for the accommodation of the cables proceeding to the machines and circuits. A room for the engineer-in-charge, at the same level, leads direct on to the gallery.

A handsome room, with ante-room having separate approach, is provided for the members of the committee, and accommodation for a resident mechanical engineer has been provided



General Plan of Generating Station.

in a small house at the corner of the site. There are also separate rooms for the men employed in the engine house and boiler house respectively, each having the necessary lavatory



Longitudinal Section of Boiler House.

accommodation. The buildings are faced externally with picked Fletton bricks, relieved with red Leicestershire bricks. The engine house is faced internally with Fletton bricks, having a glazed brick dado and strings running round the walls, with glazed brick arches to the openings. The floor is laid with vitreous mosaic. The chimney shaft, 180 ft. in height, with an internal diameter of 10 ft. at the top, is placed in the yard at the rear of the site and adjacent to the canal. The foundations of the chimney shaft and of the main walls of the buildings are taken down to the London clay, a depth of about 21 ft.

Boiler House Plant.

The boiler house plant consists of four water-tube boilers of Messrs. Babcock & Wilcox's marine type, with solid drawn steel tubes. Each boiler has a heating surface of 2,720 sq. ft., and is fitted with an economiser containing 350 sq. ft. of heating surface, making a total heating surface in the four boilers of 10,880 sq. ft., and in the four economisers of 1,400 sq. ft. It will be noticed that the floor space occupied by these boilers is very much less than with boilers of the "Land" type.

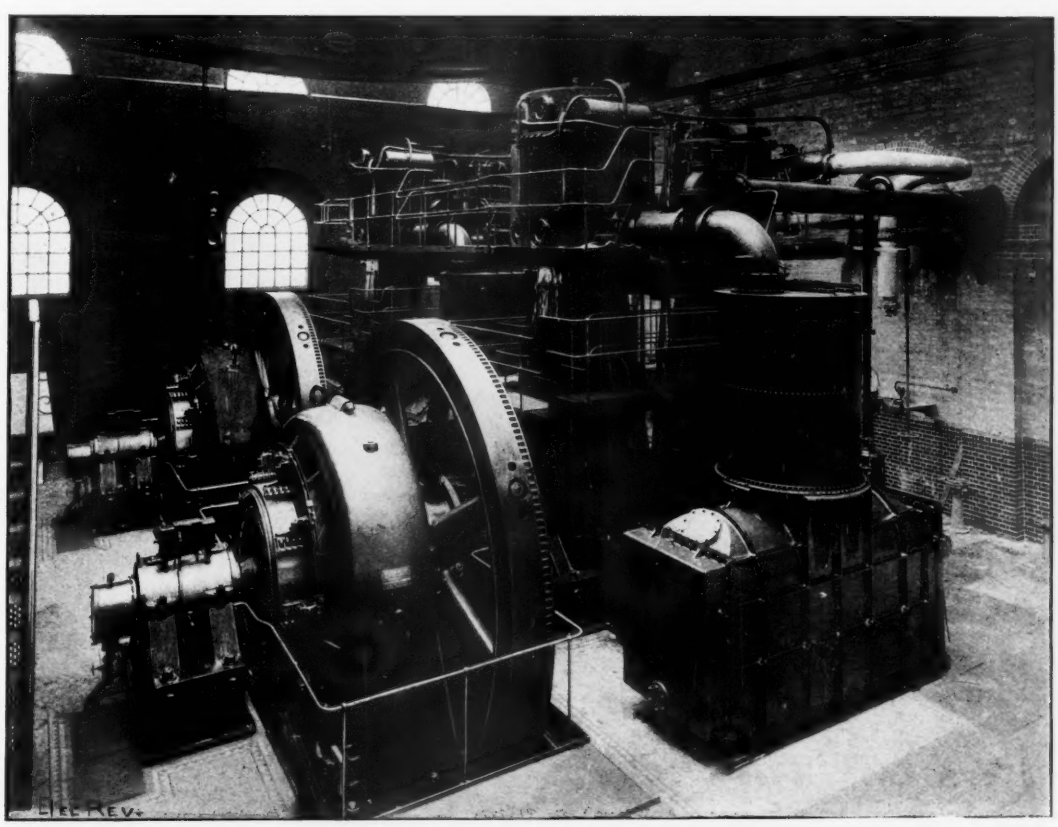
Three of the boilers are hand fired, having an ordinary grate area of 73½ sq. ft. each. The remaining boiler is fitted with a double 4 ft. patent chain-grate stoker, made by Messrs. Babcock & Wilcox. The grate area of this boiler is 68 sq. ft., the total grate area in the four boilers being, therefore, 288½ sq. ft.

These four boilers, combined with the economisers, produce about 50,000 lbs. of steam per hour, and are arranged along one side of the boiler house, the space on the opposite side of the boiler house being available for the accommodation of additional boilers whenever they are required.

Gangways are provided in the boiler house for access to the fittings in front of the boilers, and to the stop valves on the main steam range.

The products of combustion are conveyed from the boiler to the chimney through flues constructed of steel, placed overhead. The flues are lagged outside by magnesia, which is held in position by means of external plates. A chamber has been provided at the base of the chimney shaft, to which the main flue is connected; it is so arranged that induced draught apparatus can be added subsequently.

The boilers are supplied with coal from an overhead coal store, having a total capacity of 750 tons, erected on steel stanchions above the stoking floor in the centre of the boiler house. Pockets with sloping sides are provided in the bottom of these bunkers to facilitate the discharge of the coal to the boilers.



General View of Generating Plant.

The contractors for the buildings are Messrs. Johnson and Sons, of Leicester, and for the chimney shaft Messrs. Storrs and Son, of Stalybridge.

The openings at the bottom of the pockets beneath the coal bunkers are provided with regulating valves, one being placed opposite the centre of each boiler, which enables the

flow of the coal to be controlled. The coal is delivered, by means of these valves, into a hopper having a weighing apparatus, so as to correctly register the amount of coal delivered to the boilers.

For the present, the coal for the boilers which have not been fitted with mechanical stokers will be delivered on the floor in front of the boilers, as the firemen require it. In the case of the boiler fitted with a mechanical stoker, the coal will be delivered directly into the hopper in connection with the stoker.

A special feature about the boiler house is the arrangement by which the coal is lifted from barges on the canal alongside the generating station, conveyed to the bunkers and afterwards to the boilers.

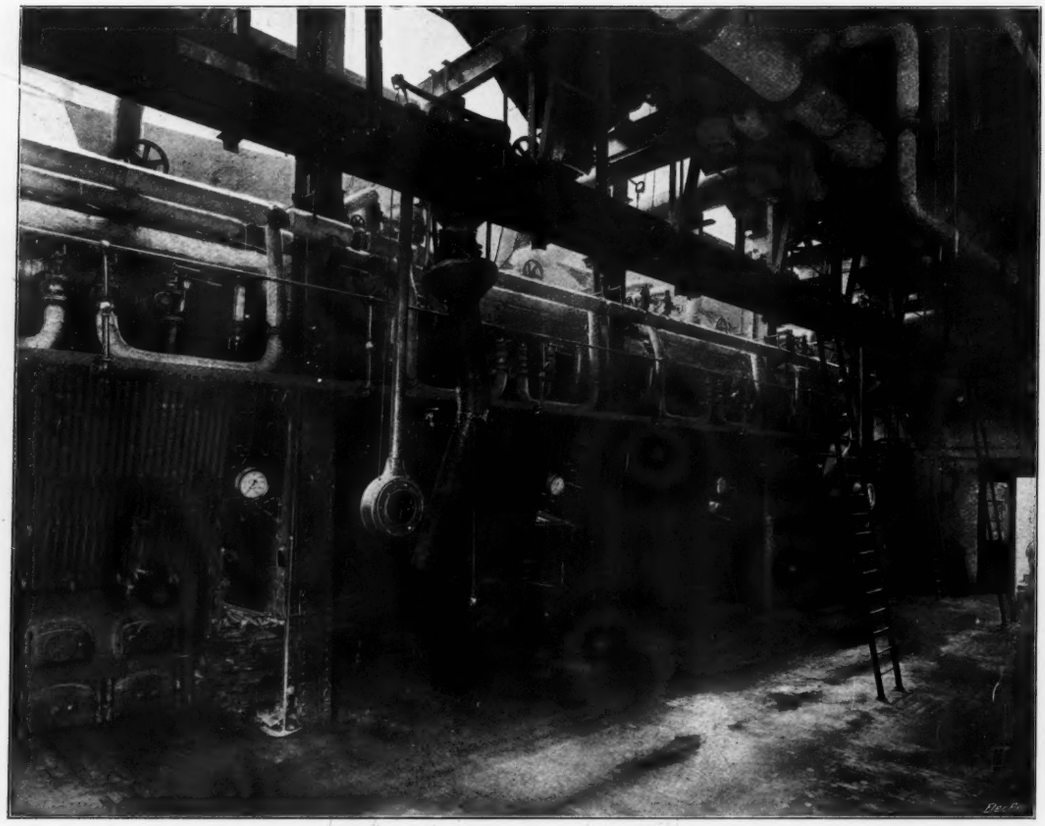
View of Exterior of Works.

The coal is lifted from barges by means of a hinged grab or shovel of $\frac{1}{2}$ ton capacity, which is suspended from a boom of parabolic form, extending over the canal. This apparatus is situated at the top of a tower constructed of steelwork, placed near the edge of the canal at the end of the boiler house.

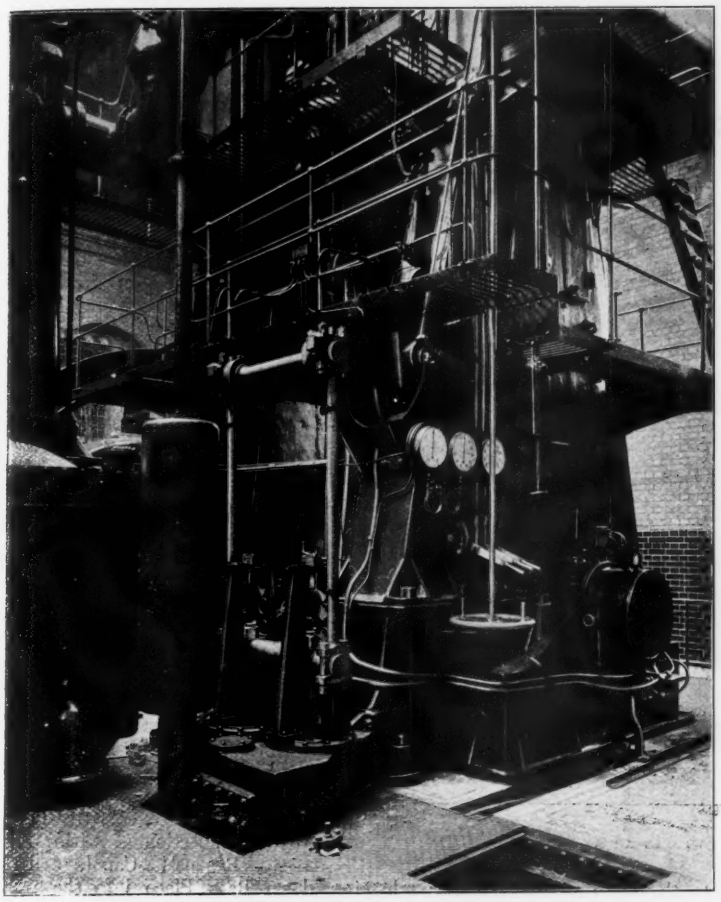
The parabolic form of the boom enables the load to be lifted vertically until it reaches its extreme elevation, when an inward movement takes place, at the end of which the coal is dumped into a hopper and delivered, through a regulating duplex valve, into an automatic wagon ; as soon as this is filled, it is released, and runs over the top of the bunkers, dumping the coal at any point where it is required.

The hoist is driven by means of two electric motors of the enclosed type, supplied by the Westinghouse Company, the speed being regulated by a series - parallel controller.

The peculiar feature of the automatic railway consists in the storage of energy by the loaded car in descending an inclined track, the energy being utilised to return the empty car to the place whence it started, after the load has been discharged. By the time the loaded car has reached the end of its journey it has raised a counter-weight a certain height by means of a cable, which the car picks up while running down the track. The weight rises only a limited distance, but when the car has dumped its load of coal, which weighs from 20 to 25 cwt., the weight falls, and in so doing pushes the car a certain distance back up the track, the momentum thus gained being sufficient to carry the car



Babcock & Wilcox "Marine" Type Water-Tube Boilers.



Wallsend Slipway Company's Engine, showing Air and Circulating Pumps, &c.

does not accompany it. The car runs with great rapidity, making the trip of 100 ft., dumping its load, and returning, in about 30 seconds.

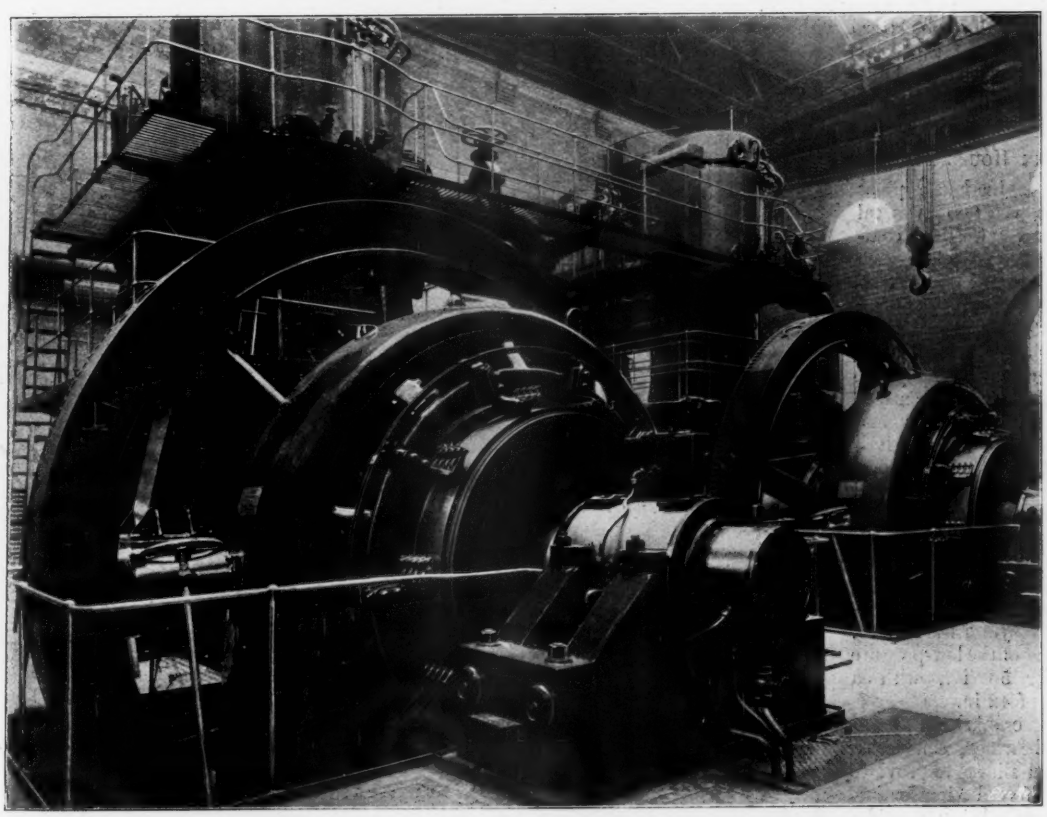
The coal-handling apparatus was supplied by Messrs. Babcock & Wilcox, and is of the Hunt Company's special design.

The whole of the steel work, comprising the coal storage bunkers, elevator tower and roof for boiler house, together with the overhead flues, has been supplied by Messrs. Peirson & Co., of St. Dunstan's Hill, E.C.

The feed pumps are three in number, two of them being capable of delivering 2,500 gallons per hour to the boilers, and the third 5,000 gallons per hour. They are of Messrs. G. and J. Weir & Co.'s make, and deliver to the boilers through the feed mains, which are in duplicate, each main being provided with a separate filter and water meter. The suction pipes to the feed pumps are also in duplicate, one pipe being connected to the overhead feed storage tank, and the other to the hot well.

The feed-water storage tank is constructed of cast-iron plates, and is capable of holding 12,000 gallons of water. This tank is divided into two sections, to enable either section to be cleaned without interfering with the continuity of the supply of water to the pumps.

The hot well consists of a galvanised iron tank having a capacity of 1,500 gallons. A special feature in connection with the hot well is that it is placed upon a weighbridge, so as to provide a ready means of measuring the water discharged from the air pump when carrying out tests on the plant.

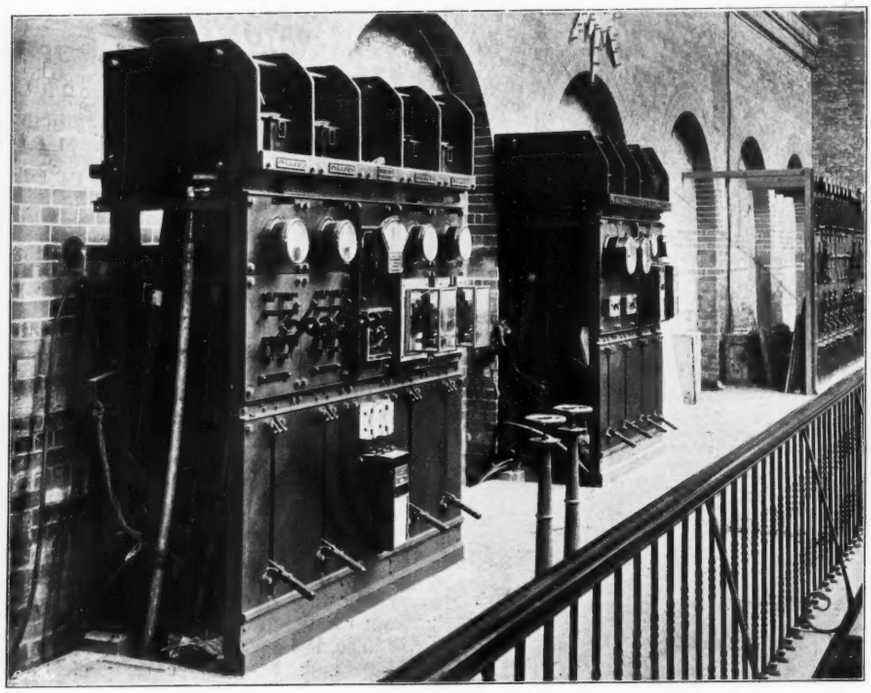


Westinghouse 800-kw. Generators.

over the remaining space. Only one man is needed to operate the railway, who starts the car when it is filled, but

The main steam pipe is arranged in the form of a ring placed in the boiler house; the main pipe is 10 in. in bore,

and is constructed of mild steel, with the flanges shrunk on and rivetted. Jointing is avoided as much as possible, and with this in view the branch connections are made by means of flanged outlets of mild steel, rivetted on to the main pipes. The ring is divided up into sections by means of stop valves, so as to limit the effect of any failure to the particular section of the ring affected. All the valves are of the straight-through pattern, with cast-steel bodies.



HIGH-PRESSURE SWITCHBOARDS.

The whole of the steam and feed piping, feed pumps, storage tank, &c., have been supplied by Messrs. Aiton & Co.

ENGINE HOUSE PLANT.

The engine house plant consists of two vertical low-speed "Corliss" compound steam engines, each direct coupled to a continuous-current generator of 800 KW. capacity. Each engine is provided with its own condensing plant, consisting of a surface condenser, with air and circulating pumps driven direct from the main engine.

The engines are designed to run at a speed of 90 revolutions per minute, and are capable of developing from 1,300 to 1,400 I.H.P. The diameter of the high-pressure cylinder is 24½ in., and that of the low-pressure cylinder 53 in., with a stroke of 42 in.

The crankshaft, generator bearings, connecting rod and slides are provided with forced lubrication, oil pumps being provided for this purpose, worked from the crankshaft. The main standards are suitably enclosed to prevent oil splashing about, large doors and movable casings being provided to give access to the working parts.

Both high and low-pressure cylinders are provided with automatic Corliss trip gear, controlled by the governor, which is of the "Whitehead" isochronous type. In addition to the ordinary governing, an emergency governor of the inertia type is provided.

The fly-wheel, weighing about 32 tons, is of the built-up type, with steel tension arms. Steel rings are shrunk on the hub as an additional safeguard.

Ladders and staging are provided for access to the valve gear and other working parts.

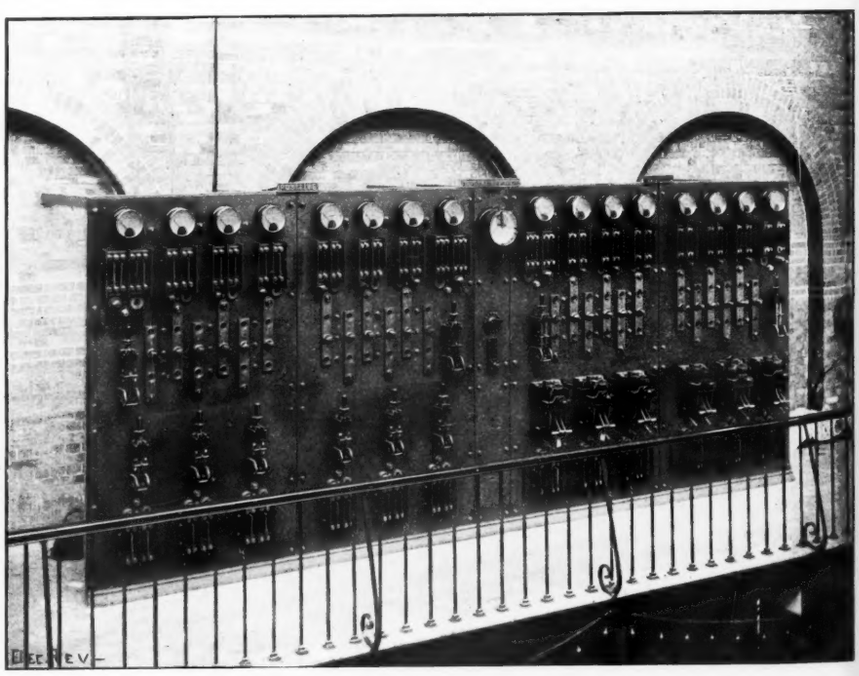
The condensers each have a cooling surface of 2,700 sq. ft. The exhaust steam from each engine passes through an oil separator on its way to the condenser.

The air and circulating pumps are driven by means of levers from the high pressure cross-head. The air pumps are of the Edwards single-acting type, the circulating water pumps being of the double-acting type.

The circulating water is taken from the basin in connection with the Regent's Canal, and is returned through pipes down Bath Place into the main canal.

An alternative exhaust to atmosphere with automatic release is provided.

The engines were manufactured by the Wallsend Slipway and Engineering Company, who also supplied the generators,



LOW-PRESSURE SWITCHBOARD

together with the exhaust and water pipes in connection with the engines and condensers.

The generators are of the multi-polar type, made by the Westinghouse Company. The rated load of each of the

machines is 730 amperes at 1,100 volts. The machines, however, are designed to carry an overload of 50 per cent. above this rating for two hours if necessary.

The armature and commutator are built upon a ventilating cast-iron sleeve, forced on the engine shaft under pressure. The field castings are divided in a vertical plane, and are mounted on cast-iron base plates. The armature is of the slotted drum type, having a multiple winding so arranged that the circuits will not become unbalanced by a slight displacement of the armature from the centre of the fields.

The brushes are adjustable by means of a hand-wheel and worm gear, and the arms carrying the brushes are supported at the end next to the field casting, so as to leave the commutator free from obstruction. The brushes are of carbon.

The arrangements for ventilation are very perfect in this type of machine; open ducts are provided for this purpose throughout the armature to the spider core and windings, the design of the spider being such as to set up a forced current of air through these ventilating spaces.

As previously mentioned, the switchboard is placed on a gallery which runs the whole length of the engine room, the high pressure portion being placed at one end and the low pressure at the other.

The high-pressure board is divided into the following sections:—

1. Dynamo board, comprising positive and negative dynamo panels for each generator, with paralleling panel in the centre.

2. Trunk feeder board, comprising positive and negative panels for two high-pressure feeders.

3. Transformer board, comprising panels for four transformers.

4. Arc circuit board, with provision for three arc circuits.

The low-pressure board consists of positive and negative feeder panels for six low-pressure feeders. This switchboard will be used in connection with the continuous current transformers for supplying the network in the neighbourhood of the station, and is arranged on the plug system, whereby any transformer can be plugged on to any low-pressure feeder.

Both high and low-pressure switchboards have been supplied by Messrs. Cowans, of Manchester, the high-pressure board being of their special design, in which the high-pressure switches are mounted on horizontal slates, and the whole supported on an iron frame placed against the face of the wall, without the necessity of leaving a space behind for access to the working parts.

All the main high pressure switches are provided with reverse current cut-outs of the Andrews type, and the switches can also be opened by means of a hand trip gear. These switches break through about 1 in. of water.

The instruments are of Messrs. Evershed & Vignoles's make, with the exception of the voltmeters, which are of the Ayrton & Mather multi-cellular type. The recording instruments are by Messrs. Elliott Bros.

A special feature in connection with the design of the switchboard is the chamber that is provided below the gallery, to contain the various resistances and the high pressure omnibus bars. The spindles for working the regulating resistances are brought up through the floor of the gallery, and are operated from a convenient height, cast-iron pillars and hand-wheels being provided. A light gangway is provided in the chamber below the board for convenient inspection of the various regulating switches and resistances.

The high pressure omnibus bars, which are carried in the chamber below the gallery, as previously mentioned, are supported on oil insulators.

In addition to supplying the switchboards for the Whiston Street generating station, Messrs. Cowans have supplied the trunk feeder panels at the receiving end of the trunk feeders at the old station in Coronet Street, and have supplied the additional switchgear for the two sub-stations at Reeves Place and Evelyn Street respectively.

It will be seen from the foregoing description that there are some essentially novel features in this, the latest undertaking of the Shoreditch Borough Council.

The marine type of Babcock & Wilcox boiler has, we believe, never before been utilised for service on land, and is expected to give the most efficient results, whilst the comparatively small ground space occupied by these boilers in comparison with their steaming capacity makes them eminently suitable for a large electric generating station.

The automatic railway for handling and trimming the coal in the overhead bunkers is also a novel feature in this country.

It will be noticed that the system of supply adopted for the new generating station is similar to that adopted by the Council in their first generating station. High pressure continuous current is generated at the power station at about 1,100 volts, and delivered to sub-stations located in various portions of the area, where the current is transformed down to the pressure required for the service to consumers' premises through continuous current motor transformers, consisting of machines with one field and a double-wound armature. The distribution from the sub-station through the streets to consumers' premises is on the two-wire system.

The opening of the new works will considerably relieve the pressure that the old station at Coronet Street has been working under for the past two years. Although the district in the immediate vicinity of the new generating station will eventually require a large plant of electricity on its own account, the new plant will, for the present, be principally employed in transmitting energy to the southern part of the borough, from which the major portion of the demand is arising.

It is well known that the price charged for electricity in Shoreditch is among the lowest in the kingdom; and to this fact, no doubt, is due the large number of new applications for supply, which are continually being received.

NOTES.

(*Continued from page* 1021.)

Opening of New Electricity Works at Shoreditch.—The new power-station of the Metropolitan Borough of Shoreditch, which is described elsewhere in this issue, was formally inaugurated on Monday last by Councillor H. B. Bird, chairman of the Lighting Committee; the Mayor, Councillor Edward Gates, presided, and a large number of members of the Council and their guests assisted at the ceremony.

In the evening a dinner was given by the engineers and contractors at the Great Eastern Hotel; Mr. Bird took the chair, and was supported by the Mayors of Shoreditch and Bath, the Provost of Partick, members of the Borough Council, and representatives of the engineers and contractors. After the loyal toasts, Mr. H. E. Kershaw proposed the "Electricity Undertaking," and mentioned that since he retired from the chair of the Lighting Committee he had had to criticise its doings somewhat, but the recent change of chairman had resulted in success. The electrical press had said much as to the wisdom of municipalising electricity supply; the Shoreditch Council settled that question long ago. But the bye-law which required a change of chairman every year, embodied an utterly ruinous system; without continuity of government the greatest business would be ruined. Mr. Kershaw spoke in high terms of the work done with the old station; he anticipated that, with the inauguration of the new one, the price and cost of energy would both be lowered, and it would be shown that, after all, the old station *could* be run with refuse alone, to deal with the whole of the day load. In reply, Mr. Bird disclaimed credit for the new station, attributing it to the late chairman, Mr. Winkler. He was proud of his Committee. The undertaking had never been a charge upon the rates in any way; a gross profit of £21,083 had been made up to the end of March last, of which £5,365 had been applied to repayment of capital, £13,812 to interest on capital, £2,922 to the dust destructor, while £250 had been devoted to the public library, and £2,000 to the reserve fund. The total, £24,349, exceeded the gross profit, and the difference appeared as a deficit in the last set of accounts. An increase of £5,000 in the receipts had resulted from steps taken by the Council to remove the deficit, which was largely due to the high price of coal in 1900—1.

The Mayor of Bath, toasting the Borough of Shoreditch, praised its progressive spirit, and pointed out that the Senior Wrangler this year was a Shoreditch scholar. The Mayor, in his reply, praised the Shoreditch Board of Guardians and the officials. Alderman Sawell also replied, paying a high tribute of praise to the work of Dr. Mansfield Robinson, the town clerk.

Mr. Manville, in reply to the toast of the engineers and contractors proposed by Councillor Styman, vice-chairman, spoke of the excellence of the work done by the contractors, and explained that the boilers were not only of British make, but were designed by Mr. Rosenthal in this country. Both these and the engines

would, he believed, prove to be most efficient. In his opinion, after expenses were paid, the benefit of reduced cost of production should be given to the consumer. The price in Shoreditch was already the lowest in London, on the average barely exceeding 3d. per unit. Messrs. Laing, for the Wallsend Slipway and Engineering Co., and Rosenthal, for Messrs. Babcock & Wilcox, also replied, Mr. Rosenthal pointing out that thanks to the skilful management of Mr. Newton Russell, the borough electrical engineer, the boilers at the old station had never cost a penny for repairs.

Mr. Manville then toasted the guests, and the proceedings closed with the toast of the chairman.

During the evening Alderman Sawell took occasion to state emphatically that for the first 18 months of working "not an ounce" of coal was used in the old station; coal only became necessary when the demand exceeded the possibilities of supply from refuse alone.

The absurd statement appears in the *Daily News*, in reference to this undertaking, that "there had been a gross profit of £21,803, which had been distributed amongst several institutions of the borough, including the public libraries!" Unfortunately for the ratepayers, the distribution was, as stated by Mr. Bird, over £19,000 being required to meet the capital charges alone.

Electrical Competition in South Africa.—The conclusion of the war in South Africa having led to the belief in some quarters that a rush will take place in order to secure electrical contracts which will doubtless be thrown open to competition, it may be interesting to reproduce the opinions entertained by the representatives of two of the large Berlin companies as to the prospects of the German industry participating in the work. These are as follow:—

The principal of one of the leading firms states that plenty of men and an abundance of capital will flow towards South Africa, and the mining industry will receive a strong impetus. As a result, the electrical industry will derive advantage, and, in addition to England and America, the German trade will also profit by it. Of course, keen competition in this connection is to be apprehended in general, and also between the German firms themselves. It is not possible for an agreement to be arrived at by German firms in regard to prices, as the individual companies produce the most varied kinds of manufactures, and even differences are exhibited in the same classes of goods.

On the other hand, the manager of the export department of one of the principal companies remarks that the English will presumably refrain from placing manufacturing orders in Germany. The German industry, however, is urgently in need of new orders, and the electrical branch especially is prepared and in a position to produce on a large scale. But not a single order has been received, whilst recently America has been given commissions for electrical manufactures to the extent of from £500,000 to £600,000. The large South African mines are equipped according to the most modern manner, and the resumption of working operations renders necessary the placing of fresh orders, especially for boring machinery, pumping plant, locomotives, hauling engines, and so forth. The leading engineers are, however, Englishmen or Americans, and their specifications expressly contain the words, "Germany excluded," but England and America are at present in a position to meet the requirements of the South African market. Germany will only receive orders when England and America are full up and can accept no more.

The Henley-Callender Negotiations Broken Off.—The following is a copy of a circular issued from the offices of W. T. Henley's Telegraph Works Company, Limited:—

"27, Martin's Lane, Cannon Street,
"London, E.C, *June 14th*, 1902.

"Dear Sir (or Madam),—We regret to say that certain differences have arisen between this company and Messrs. Callender's Cable and Construction Company, Limited, as to the terms of the proposed amalgamation, which, in the view of both boards render it impracticable, at any rate for the present; and the negotiations have therefore by mutual consent, been treated as at an end.—Yours faithfully,

"A. E. Salmon, *Secretary*."

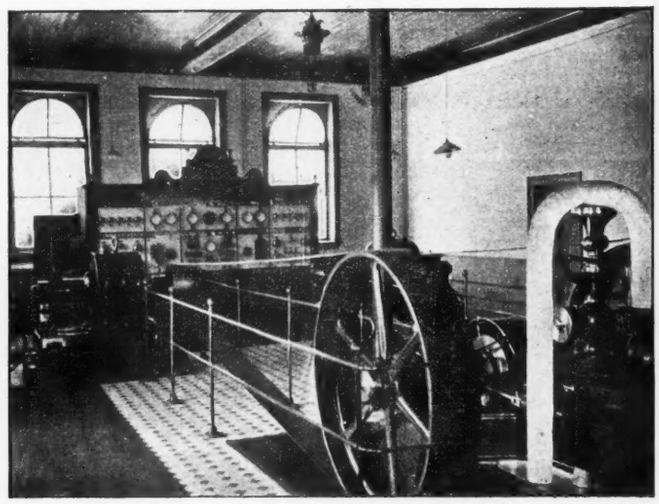
The Institution Deputation to Mr. Gerald Balfour.—On Wednesday a deputation, including Lord Kelvin as a past-president, Mr. James Swinburne, as president of the Institution of Electrical Engineers, and many other leading electrical men, waited upon the Rt. Hon. G. Balfour at the Board of Trade offices in regard to the subject of legislation and electrical industry. Lord Kelvin formally introduced the deputation, and Mr. Swinburne and Colonel Crompton acted as chief spokesmen. We shall deal with the matter at length in our next issue.

The G.E.C. Fire.—In the House of Commons last Friday, Mr. Tennant asked the Secretary of State for the Home Department whether he had yet ascertained the grounds upon which the General Electric Company had not registered their premises in Queen Victoria Street as a workshop, and whether he could state what action he proposed to take in the matter. Mr. Ritchie, in reply, said that the company did not register the premises as a workshop because they considered that they were a warehouse only, and not a workshop. There was one process carried on in part of the premises, viz, the putting together of the parts of an electric lamp holder, but Mr. Ritchie was advised that that could not be regarded as a manufacturing process constituting the premises a workshop. In any case, this question did not affect the duties of the company as regards means of escape from fire, and therefore he did not propose to take any steps in the matter. The matter had been carefully considered by the Home Office, and they had come to the conclusion that it was not a manufacturing process.

The inquest was to be resumed yesterday (Thursday) at the Guildhall.

The M.E.A. Convention.—We gave some particulars a few weeks ago of the papers down for reading at the convention of the M.E.A., which opens on Wednesday, July 2nd, under the presidency of Mr. J. H. Rider, at the Institution of Mechanical Engineers, Storey's Gate, S.W. The full official programme of papers and visits has now been placed in circulation, and copies may be obtained on application to the secretary, Mr. C. McArthur Butler, St. James's Hall, Piccadilly, W.

Electric Lighting at Pretoria.—The accompanying photograph shows the engine room at the lighting station, Artillery Barracks, Pretoria, run by the men of the Electrical



Electric Lighting at Pretoria.

Engineers R.E. Volunteers. We are indebted therefor to Co. Sergt.-Major William Holmes.

The I.E.E. at Cape Town.—An ordinary meeting of the local section of the Institution of Electrical Engineers was lately held at the South African College, under the presidency of Mr. Brackenbury Bayly, chairman of the committee. The papers under discussion were those by Messrs. Aspinall, Trotter, and Major-General Webber, on "Electric Shocks." Dr. Claude Wright and Dr. Marius Wilson took part in the discussion.

London County Council.—The Council decided on Tuesday to lend £13,925 to the Bermondsey Borough Council for electric lighting works, and approval was given to plans submitted by the St. Pancras Borough Council for the erection of two sub-stations.

Appointment of Distribution Engineer.—The Highways Committee stated that the tramway manager had represented to them the necessity for additional assistance being provided to supervise the laying of the stoneware ducts for the tramway cables and the manufacture and laying of the cables. It was desirable that the person appointed should have had experience in the actual construction and laying of cables, the theory and practice of electric testing, the location and repair of faults and be accustomed to the charge and control of men. The Committee considered that the assistance should be furnished, and on their recommendation the Council authorised the issue of advertisements inviting applications for the position at a salary of £350 per annum.

The Opening of Streets.—Some months ago the Council decided to ask the local authorities whether they would be prepared to support the Council in making a representation to the Government as to the necessity for legislation to confer on the central authority, powers to make bye-laws or regulations as to the manner in which companies should open the streets, and also to compel the companies to move their pipes and wires into subways. The Highways Committee, in reporting on the question, remarked that from the replies received, the majority of the local authorities were willing that the Council should have the power of making bye-laws, but with very few exceptions, they expressed the opinion that the enforcement of compliance with the bye-laws should be in the hands of the local authorities. The City Corporation, in a Bill intro-

duced this session, sought for further powers to regulate the breaking up of streets within its jurisdiction, but the Bill was thrown out owing to the opposition of the gas and water companies, which contended that legislation of that kind should not be by a private, but by a public Bill, and should be applicable to the whole of London, if at all. In the opinion of the Committee, it was imperatively necessary that the question should be dealt with as soon as possible, and the Council decided to ask the City Corporation to join with it in an application to the Government to promote legislation in the direction indicated, in the next session.

The Electrolytic Preparation of Persulphates.—The *Zeits. f. Elektrochemie*, of April 24th, contains details of laboratory experiments upon the electrolytic preparation of persulphates, carried out by Müller and Friedberger in the Electro-Chemical Laboratory of the Technical Hochschule at Dresden. Elbs had shown in an earlier publication, that persulphates could be produced without difficulty, by the electrolysis of acid solutions of sulphates, with the acid of a diaphragm. The authors of the present paper desired to find whether equally favourable results could not be obtained in neutral solutions in the absence of a diaphragm. The form of apparatus used for carrying out the series of experiments was based upon that first devised by Oettel, and permitted the course of the electrolysis to be watched by collection and measurement of the gases evolved at the anode and cathode of the experimental cell. Platinum was used as electrode material, and the contents of the cell were kept cool by a current of water. Potassium and ammonium sulphate solutions with and without the addition of sulphuric acid and potassium chromate, were used as electrolytes in the various experiments. The results showed that a current efficiency of 35 per cent. could be obtained in the formation of potassium persulphate, using an acid electrolyte, but no diaphragm. The efficiency when working with the corresponding ammonium salt, rose to 60 per cent, when chromate was added to the electrolyte, and the free ammonic formed during the electrolysis at the cathode, was converted into the sulphate by continual additions of sulphuric acid. These efficiencies are equal to those obtained when diaphragms are employed—while the E.M.F. required to work the cell is reduced from 8 to 5·9 volts. The authors do not state that the electrolytic processes for manufacture of persulphates are in actual operation, but according to information in our possession, the Electrolytic Chlorate Works at Mansbee, Chedde, and St. Michel are already producing both perchlorates and persulphates on an industrial scale.

Manufacture of Metallic Carbides.—A method of preparing the carbides of the alkaline earth metals (barium, strontium and calcium) has been patented by Limb, of Lyons, which consists in heating the sulphide or sulphate of the metal whose carbide is required together with carbon and some metal which easily combines with sulphur in the electric furnace. It has been proposed before to heat mixtures of alkaline earth sulphides or sulphates with carbon in an arc furnace; but not only does such a progress demand a current of very high voltage, it also takes place somewhat slowly and by no means quantitatively. The feature of the present invention, accordingly, is the addition of a metal to the previous mixture, which metal combines with the sulphur and assists the decomposition. Tin or lead may be employed in order to gain the advantage of their ready fusibility, which makes the charge a better conductor of heat; or iron, or its oxides, may be similarly adopted. For instance, 100 parts of barium sulphate are roasted with 34 of coke, when barium sulphide mixed with an excess of carbon results. The product is powdered, incorporated with 36 parts of iron filings, and ignited in an electric furnace. Using the oxide of iron, the proportions are 100 parts of barium sulphate, 43 of coke, and 35 of ferric oxide. The residue is treated with water, preferably hot, when 10 parts by weight of acetylene are liberated and can be employed for any desired purpose, while 100 to 120 parts of barium hydroxide (caustic barvta) pass into solution, and can be crystallised out. Forty parts of manganese oxide may be substituted for the iron. Either direct or alternating currents are permissible in the furnace; the former tends to set sulphur free.

Marriage.—Mr. Percy P. Gutteridge, youngest son of E. N. R. Gutteridge, of Edmonton and Brighton, who is on the staff of J. G. White & Co., Limited, of London and Bilston, and late of the Sir Hiram Maxim Electrical Engineering Company, was married on June 15th, at Bilston, to Ellen Amelia Rudkin, eldest daughter of C. H. Rudkin, of Enfield Wash.

The Electric Furnace.—The *Electrochem. Zeitschrift* of May contains an interesting mathematical article by M. Gustave Gin, relating to the electric furnace. Assuming the correctness of certain physical constants at the high temperatures of the arc and resistance furnaces, M. Gin shows that the temperature and efficiency of the furnace in the neighbourhood of the electrodes can be calculated with approximate accuracy. When arc heating is employed, the correctness of the ordinary constants for resistance and specific heat of the gaseous envelope surrounding the arc, is, however, highly doubtful, and M. Gin's formula is likely to yield incorrect results. He, nevertheless, claims to have proved that the temperature of the arc will increase as the square of the current density, whether the medium separating the electrodes be in the gaseous or fluid condition. The problem as regards resistance furnaces, though simpler than that relating to arc furnaces, is still a somewhat complicated one, and M. Gin gives a series of formulæ for calculating the temperature and efficiency of these. The results obtained indicate that the efficiency of the electric furnace as a heating agent diminishes with diminishing temperature, and that, conversely, it increases with increase in the amount of heat absorbed by the physical and chemical changes in the substances operated on. This latest contribution by M. Gin to the theory of electric heating should be read in conjunction with an earlier one contributed to the Academie des Sciences in 1898, and reprinted in *Comptes Rendus*, 126, p. 236.

Late Letter.—As we go to press a letter has come to hand from Lieut.-Col. Crompton regarding our last week's note on "A Scandal which Everybody Admits." This will appear in our next issue.

THE CENTRAL STATION ENGINEER.

On Wednesday, the 10th inst., Mr. H. S. Goodger, the station superintendent of the Bournemouth and Poole Electricity Supply Company, Limited, on the occasion of his marriage with Miss Mary Charlotte, daughter of Mr. and Mrs. H. Pardey, of "Wilverley," Parkstone, was the recipient of a handsome set of carvers from the engineering staff and a very handsome marble clock from the employés, as a token of their esteem and best wishes for his future happiness and prosperity.

Mr. A. C. Cramb, of West Hampstead, has been appointed chief assistant at Croydon.

The staff of St. Annes-on-Sea electricity works presented to Mr. Tiddeman, on his departure for Stoke, an oak and silver tray.

Mr. E. E. Putland, who has for the past seven years been chief engineer and manager of the Aberystwith Electric Supply Company, is leaving to rejoin the technical staff of Mr. G. Croydon Marks, and will have charge of important work in Manchester.

At the monthly meeting of the Town Council at Falkirk, N.B., on Monday, the appointment of Mr. John McMillan, of Edinburgh, as senior assistant superintendent of mains at the Edinburgh Corporation electric lighting department, to the position of resident electrical engineer at Falkirk, was confirmed.

At the meeting of the Sunderland Town Council on the 11th inst. the Electricity and Lighting Committee recommended that the resolution of the Council of December 14th, 1898, as to the appointment of Mr. J. F. C. Snell, as borough electrical and tramways engineer, be varied or rescinded so that his engagement should be for five years from the date of the meeting at a salary of £1,000 per annum. Alderman Bruce, in moving the adoption of the report, said Mr. Snell had had numerous invitations from various authorities and companies to act as their professional adviser, and the most recent offer was from a London firm of civil engineers who had charge of several tramway undertakings, who asked Mr. Snell to take charge of the work of their conversion from horse power to electrical, and there was an offer of partnership. Under these circumstances the Committee felt that they would rather increase Mr. Snell's salary than lose his services at an early date. His present salary was £800, so that they proposed to increase it by £200; the tramways would pay £400, and the electricity undertaking £600. The engagement would be for five years. The report was carried without a dissentient. The Tramways Committee concurred with the proposal.

Mr. G. A. Benyon, senior switchboard attendant at the Bolton Corporation electricity works, has been appointed to the position of shift engineer to the Halifax Corporation electricity works.

NEW COMPANIES REGISTERED.

Christian & Phipps, Limited (73,843).—This company was was registered on May 27th, with a capital of £5,000 in £1 shares (3,500 preference, 1,000 founders, and 5,000 ordinary), to acquire the business carried on at 24, High Street, Hampton Wick, as "Christian & Phipps," to adopt an agreement with A. Christian Gibbons, and to carry on the business of electricians, mechanical engineers, manufacturers of all kinds of electrical apparatus and appliances, general engineers, founders, smiths, machinists, car and carriage makers, producers and suppliers of electricity for the purposes of light, heat or power, wire and cable manufacturers, &c. The first subscribers (each with one share) are:—A. C. Gibbons, 24, High Street, Hampstead; G. W. Green, civil engineer, 12, Mortlake Road, Kent; H. Myram, electrical engineer, Belmont, Fairfax Road, Hampton Wick; W. R. Estall, accountant, Derwent Villa, Kingston Road, Teddington; R. Poole, mechanical engineer, 12, Tudor Road, Norbiton; A. Patey, solicitor, 42, Finsbury Square, E.C.; and E. D. Poole, dentist material manufacturer, 19, Poland Street, W.C. No initial public issue. The first directors are J. S. Gibbons, J.P., A.C. Gibbons, M.A., A.I.E.E., R. Poole, A.M.I.M.E., G. W. Green, A.M.I.C.E., and A. C. Pool; qualification, £250; remuneration as fixed by the company.

Thornton and Atkinson, Ltd. (73,995).—This company was registered on June 9th, with a capital of £3,000 in £1 shares, to acquire the business of engineers, carried on by H. Thornton and A. R. Thornton, at Providence Foundry, Cleckheaton, Yorks, as H. and A. R. Thornton, and the business carried on by J. N. Atkinson and E. C. Harris at Borough Mills, Bradford, as the Bradford Electrical Company, and to carry on the same. The first subscribers (each with one share) are:—H. Thornton, engineer, Eddercliffe House, Cleckheaton; J. N. Atkinson, engineer, 57, St. Andrews Villas, Bradford; W. Beanland, chartered accountant, 2, Darley Street, Bradford; A. F. Mossey, solicitor, 1, Cheapside, Bradford; E. C. Harris, electrical engineer, 10f, Wareley Road, Bradford; R. Thornton, retired engineer, Eddercliffe House, Cleckheaton; and A. E. Rhodes, architect, Denehill, Liversedge. No initial public issue. The number of directors is not to be less than three nor more than five; the first are H. Thornton, A. R. Thornton and J. N. Atkinson; qualification, £300. Registered office, Providence Foundry, Cleckheaton.

Kilmalcolm Electric Lighting Co., Ltd. (5,124).—This company was registered in Edinburgh on June 12th, with a capital of £10,000 in £1 shares, to carry on in Kilmalcolm or elsewhere the business of electrical engineers, electricians, engineers and contractors, suppliers of electricity, manufacturers of electrical apparatus, mechanical and chemical engineers, &c. The first subscribers are:—R. Barr, Kilmalcolm, bonded warehouse proprietor, 500 shares; W. A. Sloan, Larkfield, Kilmalcolm, manufacturer, 100 shares; A. Wallace, Heatheryknow, Kilmalcolm, merchant, 200 shares; J. Parker, Clovelly, Kilmalcolm, physician, 200 shares; T. Barr, Abington, Kilmalcolm, coal master, 100 shares; J. Fullarton, Thornwood, Kilmalcolm, timber merchant, 100 shares; and G. Macdonald, 116, Hope Street, Glasgow, C.A., 50 shares. The number of directors is not to be less than four nor more than 10; the first are R. Barr, T. H. Barr, J. Fullarton, Dr. J. Parker, W. F. Salmon, W. A. Sloan and W. B. Stirrat; qualification, £100; remuneration as fixed by the company. Registered office, 116, Hope Street, Glasgow.

OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

Accumulator Syndicate, Limited (52,514).—This company's annual return was filed on May 5th, when the entire capital of £30,000 in 20,000 shares of £1 each had been taken up. £1 per share has been called up on 5,000 shares, resulting in the receipt of £5,000. 25,000 shares are considered as fully paid. Mortgages and charges: £375.

Lyndhurst Electric Lighting and Traction Company, Limited (67,454).—This company's annual return was filed on March 22nd, when 1,750 shares were taken up and paid for in full out of a nominal capital of £6,000 in £1 shares. Mortgages and charges: *nil*.

Hove Electric Lighting Co., Ltd. (26,942).—This company's annual return was filed on March 26th, when 12,745 shares were taken up out of a nominal capital of £100,000 in 20,000 shares of £5 each. £5 per share has been called up on 12,000, and £3 per share on 745, resulting in the receipt of £62,232 (leaving £3 in arrears), in addition to £336 paid in advance of calls. Mortgages and charges, £25,000.

Norwich Electricity Co., Ltd. (30,694).—This company's annual return was filed on April 29th, when 8,750 shares were taken up out of a nominal capital of £100,000 in 10,000 shares of £10 each. £87,500 has been received. Mortgages and charges, £36,400. Note.—On May 14th the company resolved "That the Bill now pending in Parliament, intituled 'A Bill to authorise the transfer of the undertaking of the Norwich Electricity Co., Ltd., to the Corporation of Norwich and for other purposes,' be and the same is hereby approved." Resolution confirmed May 30th.

Northwich Electric Supply Co., Ltd. (46,958).—This company's annual return was filed on May 17th, when 3,000 shares were taken up out of a nominal capital of £25,000 in 5,000 shares of £5 each. £15,000 has been paid. Mortgages and charges, £5,000. 549 shares have been allotted since date of above return.

CITY NOTES.

Electrical Power Distribution Company.

THE following is a copy of the directors' report, submitted to the fifth ordinary general meeting, held at Hamilton House, Victoria Embankment, E.C., on Monday last, 16th inst.:—

"The directors beg to submit their report and statement of accounts for the year ended March 31st, 1902.

"*Profit and Loss Account.*—The profits, including £10,329 9s. 4d. brought forward from last year, amount to £31,839 10s. 6d., and after deducting the proportion of general expenses chargeable to revenue, and the expenses incurred in connection with schemes not proceeded with and written off, and a sum of £1,189 1s. 10d. added to the reserve in respect of new schemes in course of development, there remains a net profit of £26,694 14s. 9d., which the directors propose should be applied as follows:—

General reserve fund	£15,000	0	0
Payment of income-tax	731	18	11
Reduction of furniture account	65	5	4
Dividend at the rate of 6 per cent. per annum on preference shares accrued to March 31st, 1902, from the dates on which calls and instalments were paid	1,050	8	1
Dividend at the rate of 5 per cent. per annum on ordinary shares for 12 months or from the dates on which calls and instalments were paid	6,711	3	5
Carried forward to next account	3,145	19	0
	£26,694	14	9

"*Capital Account.*—In accordance with the intention expressed in the last report, the directors issued 15,000 preference shares of £10 each in November last. The subscription of this issue was guaranteed at par as to one moiety, by the British Electric Traction Company, Limited, and as to the other moiety, by the Brush Electrical Engineering Company, Limited, under agreements dated April 13th, 1899. The expenses of the issue were borne by those companies, and they became entitled to receive the premium of £1 per share at which the shares were issued.

"The subscribed share capital is now:—

£150,000	in preference shares of £10 each.
149,800	in ordinary shares of £10 each.
200	in deferred shares of £1 each.
	The holders of the deferred shares have, by agreement dated October 20th, 1900, given the company the option, exercisable at any time within ten years from January 1st, 1900, to extinguish the special rights attaching to such shares on the basis of the payment of £10,000 in cash.
£300,000	

"*Contracts and Undertakings.*—The total amount expended on electric power Acts and on new schemes in course of development, including a proportion of general expenses, but after writing off expenses incurred in respect of schemes not proceeded with, and deducting amount reserved, is £19,239 4s. 7d.

"*Investments.*—The total expenditure under this head is £58,940 5s. 6d.

"*Proposed Absorption of the Company by the British Electric Traction Company, Limited.*—A large proportion of the shares in the company is held by the British Electric Traction Company, and several directors of the company are also directors of the B.E.T. Company. Moreover, there is an identity of interests between the two companies in other respects in which unity of administration will be of advantage. Your directors have therefore come to the conclusion that in all the circumstances it is desirable that the company should be merged in the British Electric Traction Company, and they recommend the shareholders to accept a conditional offer which has been made by the British Electric Traction Company to issue its shares in exchange for shares in the company with a view to the liquidation of the company. The offer is that the shareholders in the company should receive a fully paid ordinary or preference share in the British Electric Traction Company in exchange for each fully paid ordinary or preference share held by them. With regard to the deferred shares, the B.E.T. Company have agreed with the holders of these shares, in the event of the B.E.T. Company acquiring the majority of the ordinary and preference shares in the company, to purchase the deferred shares within 12 months from June 3rd, 1902, at the price of £10,000, payable at the option of the B.E.T. Company either in cash or in B.E.T. ordinary shares at the market price of the day the option is exercised. Messrs. E. Garcke, J. S. Raworth, R. Percy Sellon, and W. L. Madgen, directors of the company, hold the majority of these deferred shares. The right of the holders of the ordinary shares to receive the dividend now proposed to be paid will not be affected in any way, and the ordinary shares in the B.E.T. Company to be issued to them will rank for dividend as from April 1st last. The dividend accrued on the preference shares to date will pass to the purchasers, but the 6 per cent. cumulative preference shares of the B.E.T. Company will rank for dividend from February 15th last. The director who retires this year is Mr. R. Percy Sellon, who is eligible for re-election. Messrs. Wright and Wake, the auditors, also retire and offer themselves for re-election."

Mr. GARCKE, who presided at the meeting on Monday, in moving the adoption of the report, said he trusted that they might take the fact that so few shareholders had thought it necessary to attend the meeting that the majority of them took the report and accounts as satisfactory. In view of the fact that the report contained a very important proposition which the directors had received from the B.E.T. Company to the effect that the shareholders would be invited to exchange their shares in the E.P.D. Company for B.E.T. shares, and in view also of the fact that the B.E.T. Company held their meeting that morning, and approved the suggestion which the board of that company made that such an offer should be submitted to this company, it seemed opportune that he should at once proceed to refer to the matter, and he would take this opportunity of explaining somewhat fully what were the reasons for the proposed merging of the E.P.D. Company into the B.E.T. Company. At the outset he would explain as clearly as he could the manner in which the E.P.D. Company was formed. About four years ago Mr. Raworth, Mr. Sellon, Mr. Madgen and himself came to the conclusion that there was a very wide scope for work in developing electrical power for various purposes in this country. At that time neither the B.E.T. Company nor the Brush Electrical Engineering Company—both of which companies had since taken keen interest in the E.P.D. Company—felt that the particular work of development was within their province, and it was, therefore, decided that it was necessary to form a separate company for the purpose of carrying out that very important work. Neither of those companies took any part whatever in the inauguration of the E.P.D. Company. The initial risks and responsibilities were taken by the directors just named. The only consideration they decided to receive for the responsibilities, and for several years' work that ensued, was in the form of 200 deferred shares for which they paid cash, and which were entitled to certain rights after a dividend of very ample dimensions had been paid upon the ordinary shares. They were to remain in that position because they felt confidence in the work that they were entering upon, and they felt satisfied to rely upon the results of that work for their remuneration. Sometime afterward, however, it became necessary to appeal to the public for further capital, and it was then pointed out to them that the existence of deferred shares or founders' shares was a bar to the raising of additional capital that the company needed for carrying on its work; and to meet that objection the four holders of founders' shares agreed with the company that it should have at any time within the next 10 years from that date the right to extinguish the special rights attaching to those shares in consideration of £10,000 in cash. Again they were perfectly willing to wait their time, and to postpone the date for receiving any *quid pro quo* for the services which had been rendered. The company was to be at liberty to exercise that option whenever it chose during the long period of 10 years, and if during that time the company had not been a success it must be assumed that the company would not have exercised its option to extinguish that special right by the payment mentioned. If, on the other hand, the company became a very large success, they felt that the sum they agreed to accept was within reason and a sum they could fairly take without any reproach to themselves. That was the position when the B.E.T. Company and the Brush Electrical Engineering Company found the company and decided to take a large interest in its further development, which they did for these reasons:—Firstly, the Brush Company as a manufacturing concern desirous of obtaining orders for its plant and manufactures, made an agreement with the E.P.D. Company, by which it received preferential consideration in the placing of orders for plant. The B.E.T. Company, on the other hand, became alive to the fact that the future course of electrical work would be in the direction of combining electric lighting with electric traction schemes. The policy of establishing large central power generating stations for the distribution of current for large areas had not until then been fully realised. Electricity had grown from small things and developed into the very big industry it had become, and they had not always been as wise as they presumed to be to-day. At one time it was thought that electric lighting would be confined to small and populous areas, but things were very different now. The directors felt the big power Bills entitling the owners to distribute electricity over those large areas to sparsely populated districts as well as to the densely populous towns would become very valuable property, and in that way it transpired that many of the schemes which this company was developing could be better worked in conjunction with the traction schemes which the B.E.T. Company was promoting in the same districts. There was

another element, which was perhaps more of a personal character, which had brought those companies into very close contact and established a very strong identity of interest, and it was that fact that practically the same men were doing the work in the various departments. What they felt now was that it would mean a very great economy of time on the part of the various directors and officers concerned in those undertakings if instead of working the undertakings separately they could work them unitedly and for the benefit of one group of shareholders. He did not discourage emulation between different companies, or despise the beneficial effects resulting from competition, but when that emulation was done by the same persons in different categories it ceased to be beneficial and was not convenient. It was all very well when those companies could be carried on by separate individuals, but in this particular case it was rather embarrassing to himself as managing director of the B.E.T. Company and as chairman of the E.P.D. Company to distinguish fairly between representative interests of the shareholders in the two companies. They had, therefore, all come to the conclusion that the right and prudent policy for the two companies to pursue was to merge their interests and to combine their forces, and to carry on that important work in the interest of one body of shareholders instead of two. That brought him to the terms that had been suggested for this proposed amalgamation or merging of interests. It was very curious to observe the different manner in which a question of this kind was regarded by interested parties. Some shareholders in the B.E.T. Company thought that too much was being paid to the shareholders in the E.P.D. Co. On the other hand, he had received two letters from shareholders in the E.P.D. Co. who protested, though not very strongly, that the consideration which the E.P.D. shareholders were offered by the B.E.T. Company was not good enough. It was necessary, therefore, that he should say a few words in order to show that the terms proposed were fair to all parties. He could not say more than that. The attempt was not made to make them unduly favourable to the E.P.D. Company; they occupied a dual position, and had had to be very careful indeed that the terms were such that they could conscientiously recommend to both parties of shareholders as fair and impartial. Their shares cost them £11 each, both ordinary and preference, and they were asked to exchange an ordinary share, for which they had paid £11, for a B.E.T. Company ordinary share which stood in the market at £14, and a preference share, for which they had paid £11, for a B.E.T. preference standing in the market at about 12½. The *prima facie* view of those terms rather supported the view of the B.E.T. shareholders, which thought E.P.D. shareholders were receiving too much, but if he had to address the B.E.T. shareholders, he thought he could adduce many reasons why the bargain should be carried out, notwithstanding the *prima facie* view. His duty, however, was to address the E.P.D. Company, and to satisfy its shareholders that what they were doing was in their interests, and not, as one gentleman had written, venturing to say that the directors had looked after themselves but not the shareholders. The right view to take about the matter was surely this: the B.E.T. Company had been established now seven years; it had done, he thought, a good work, and a work that the shareholders in that company were thoroughly satisfied with, but notwithstanding the good dividend it was paying, such was the difficulty on the part of the general public to appreciate the enormous potentialities of sound electrical concerns, that the shares stood only at about £14 for the ordinary. He proposed to the shareholders of the E.P.D. that after four years of similar work they should put themselves into the position that the B.E.T. occupied to-day. That was a fair way of putting it, but he might put the position even more strongly than that. The offer which the B.E.T. Company would make to each shareholder in the E.P.D. left it open for the offer to be accepted or declined, the shareholder might do as he liked—he might accept the exchange of shares, or remain in a still smaller minority than he was at present. If it were not for the fact that the B.E.T. Co. and the Brush Company together held a very large proportion of the capital of the E.P.D.—speaking roughly, close upon 14,000 ordinary shares out of about 15,000, and about half the preference shares—it would probably have been very much more difficult to have convinced the B.E.T. Co. that the arrangement was a fair and equitable one. It was entirely optional on the part of the shareholders whether they accepted the offer or not, but it he could divest himself of the personal interest that he had in the transaction he would be disposed to use pressure to induce the shareholders to make the arrangement. In view, however, of the fact that he and some of his colleagues were personally interested to the extent disclosed in the report in the arrangement going through, it was impossible for him to do otherwise than put the facts fairly and fully, and leave it entirely to their discretion as to what they must do. It was not necessary to defend his colleagues and himself against the suggestion that this was a deal which was suggested by their (the directors') interests. They could only say solemnly and conscientiously that they did that work because they liked it and they had the fullest confidence in the results of it, and if the arrangement were not made, they would be perfectly content to remain with the rights to which they were entitled, and which were given to them freely at a time when the results of the work done were not anticipated. As to the position of the company, he thought he could put before them a satisfactory statement not only of the position of the company, but also of its future prospects. The company possessed two Power Bills or Acts of Parliament, one for the very important industrial manufacturing area of the county of Durham, including the whole south side of the Tyne. It was not possible probably to find a more promising area for the distribution of electricity for power purposes, and it was in that area that the B.E.T. Co. were carrying out several very important electrical tramway and light railway undertakings. The E.P.D. owned another Power Bill for the very important area of North London—the North Metropolitan Power Scheme—which district they believed to be capable of very considerable extensions, both with regard to industrial and residential purposes. It was in that district again that the B.E.T. Co. were promoting and carrying out a very important electric tramway enterprise, and they had no doubt but that the greater travelling facilities which would be afforded by that scheme would enormously expand the industrial character of that district, with the result that a very large demand for electricity might be anticipated. Those Power Acts, he might mention, were regarded by Parliament in perpetuity subject to certain conditions. They would serve to fill up all the various interstices in those large areas which could not be supplied with electricity from small local generating stations, and if any of them looked back upon the progress of the electrical industry during the last 20 years, what might they look forward to when they had a Power Bill for two important areas, such as he had described, when they held them in perpetuity? The company also possessed 17 electric lighting orders and three tramway and light railway orders, and three other provisional orders which had received the sanction of the B. of T., and were now awaiting Parliamentary confirmation. That was what they had done during the past few years in the matter of electrical promotion, but they had also done a large amount of practical work. They had probably heard and seen criticisms which went to show that they were merely company promoters, and obtained those powers with the object of selling them and putting money into their pockets, but they could, in the course of their lives, point to very important constructional engineering works that had been carried out. In the short time that they had been at work they had erected no less than eight electric power stations in different parts of the country; they were small ones, but they were working, and satisfactorily. They had small capital, but, notwithstanding their smallness, he was glad to say that they were all self-supporting, and promised to become remunerative at a very early date, and he must say that they were very much indebted to Mr. Madgen, the managing director, who had been able to demonstrate, by special methods, that he had been able to bring to bear upon that business that small electric light stations established with a view of being made local distributing centres in the big Power Bills, could be made remunerative at a comparatively early period. It was the theory of many electrical men that they could only generate and distribute electricity in very large quantities at a remunerative rate, but the work that this company had done, and was still doing, would demonstrate in the engineering work they had carried out that, with economy and sound and careful methods of administration, even those small stations, which were more in the nature of sub-stations to be subsequently covered by big power stations, could be made remunerative. The company had also carried out a tramway scheme at Weston-super-Mare in conjunction with the electric lighting, and one or two others were in course of construction; so, from what he had stated, it would be seen that this company was doing very much the same work that the B.E.T. Company was doing, and it became a little embarrassing to work for separate sets of shareholders in all those various matters. Turning to the accounts, how were the profits earned? It had been said that they were not yet in a position to earn profits from the running of electric lighting stations, and therefore these profits must have been made to some extent, perhaps largely, out of what might be called promotion or construction profits. He said at once that that was the correct answer. This company and the B.E.T. Company found it necessary to do the work which was absolutely necessary in all those various departments. They not only promoted Parliamentary and other powers, but they subsequently undertook the work of construction, and when that was completed they carried on the operation or the running of the undertakings, and if all of those various functions were separated and in the hands of different parties, each set of men would make a profit out of that work; the promoter of Parliamentary powers could not work entirely for the future or for the benefit of the engineers who subsequently constructed; neither could the engineer who constructed be satisfied to hand over the whole of his hard work without any remuneration, for the benefit of those who would run the undertaking afterwards. If those various enterprises were carried out by separate groups of men, each group would make its profit upon its portion of the work. When those works were carried out each party endeavoured to make its profit at the expense of the other party; the promoter who confined himself to promoting Parliamentary powers would try to sell that Act of Parliament at the highest possible figure to the parties whose duty it was to carry it out. The E.P.D., however, combined all those functions, and so if a profit could be made legitimately out of each department, this company was entitled to make that profit, otherwise they would be prejudicing one period of the company's existence, and one portion of their efforts for another period of time in the history of the company, and another set of efforts, therefore they combined all those functions, and it became necessary to combine all the profits—they could not separate one from the other. As a matter of fact, the result of combining all those various functions, and carrying them out consistently was very much more to the advantage of the public than the other method, because they would never promote an Act of Parliament unless they felt sure that it could be carried out with benefit to the public and with profit to themselves. They never put themselves into the position of promoting a Bill which they could not carry out. They promoted these undertakings because they had confidence in their future operation, and therefore they did not load them with unreasonable profits; they only apportioned to the promotion efforts and period of time spent in promoting, such part of the ultimate profits as was fairly allocatable to that portion of the work. The same remarks applied to the engineering work, and the net result was that those undertakings were less capitalised than they would be if carried out by separate sections of men. After a few words in reference to

the balance sheet, the Chairman formally moved the adoption of the report.

This was seconded by Mr. MADGEN, and carried unanimously after questions had been asked by one shareholder and answered.

Mr. R. P. Sellon was re-elected a director.

On the motion of Mr. SYDNEY MORSE, the directors' fees for the past year were fixed at £750. Messrs. Wright and Wake were re-elected auditors, and a vote of thanks moved by Mr. G. OFFOR was carried unanimously.

The British Electric Traction Company.

THE sixth ordinary general meeting of the shareholders of this company was held on Monday at Hamilton House, Victoria Embankment, Sir Charles Rivers Wilson, G.C.M.G., C.B., in the chair.

The CHAIRMAN, in proposing the adoption of the report, said he was very glad to be able to point to an improvement and extension of business in almost every direction. The profits for the year were £203,269 as compared with £113,598, and they were able, notwithstanding the much larger capital on which they had had to pay interest and dividends, not merely to maintain the same dividend of 9 per cent. for the year, but to carry forward to the next account £27,438, while they brought into the year's account only £21,457, and that was notwithstanding that they had made ample reserves. The profit and loss account included various sums amounting in all to over £23,000, which they had applied to writing down the book values of their various assets. Turning to the balance-sheet, it would be seen that there was a considerable enlargement of figures all round. The capital in shares and debentures was practically larger by £1,000,000 than the year before. The reserve fund showed an increase of £121,184, and stood now at the respectable figure of £459,705. The amount owing to sundry creditors was about £21,000 less. Turning to the asset side of the balance-sheet, it consisted practically of three items in addition to the cash, the office furniture, and the goodwill accounts, and those three items, which represented the contracts and undertakings, the investments, and sundry debtors, showed an aggregate increase of over £1,000,000. The amount standing against the contracts and undertakings was more than £400,000 less than last year, while sundry debtors were close upon £500,000 more than last year. The amount standing against investments was about £1,000,000 larger. The reason that the amount of that account was larger than last year was that during the past year they had been able to complete a large number of their pending arrangements with other companies, and had been able to complete the sales of a number of those undertakings, and the purchase price in respect of the same had either been paid or was due to them by other companies. The expenditure on works and undertakings on account of other companies was £26,725, as against £350,375, and the expenditure on works and undertakings owned or leased by the company was only £99,998, as compared with £235,645 in the previous year. The amount expended on schemes in course of development and on Acts of Parliament and other powers was £72,465, as against £54,314. The increase was explained by the fact that at the end of March they had several very large schemes on their books which were now in course of maturing. The fact that the account for contracts and undertakings was so very much less this year as compared with last, indicated the progressive character of the work they were doing, and showed that the schemes and undertakings which they had in hand last year had not become stagnant, but had developed into sound marketable assets. There was one undertaking which he ought to refer to which had been a cause of great disappointment to them—he meant that of the Pontypridd and Rhondda Valley tramways. That was a horse tramway when they acquired it, with the object of converting it to electric traction. They made applications to the Light Railway Commissioners for the necessary powers, but had been seriously opposed by the local body as well as by the railway company; and the time was fast approaching when the local authority would be empowered to come in and purchase the lines under the Tramways Act. The desire for the municipalisation of these undertakings was so keen with some people that the sacrifices to the industrial world and to the community generally which such a policy involved, did not seem to weigh with the local authorities. At Pontypridd they had been working several years, and had done everything possible to improve the service, but apparently they had been defeated at every stage. However, they had not given up hopes of accomplishing something even yet. The amount involved was not large, but the point involved an important question of principle which would have to receive the attention of the Board of Trade. As showing the progressive nature of their various undertakings, he might tell them that the number of passengers carried had in two years increased from 55,000,000 to 97,000,000, and the traffic receipts had increased from £315,000 per annum to £563,000. The total route mileage of the undertaking in which they were interested amounted to 466 miles, of which 296½ miles were at present working by steam, horse, or electric traction, and 168½ miles were under construction or reconstruction for electric traction. Among the most important of their new schemes referred in the appendix of the report was that of the Metropolitan Electric Tramways. That was a very important enterprise, upon which Mr. Garcke and Mr. Devonshire had been quietly engaged during the past four or five years. It was a scheme of large proportions, and had called for a very considerable amount of delicate negotiations, and he was glad to say that all the difficulties of its initiation had now been overcome, and they were on the point of carrying out what would be one of the largest electric tramway systems in the United Kingdom. When the scheme was completed there would be at least 130 miles of electrical tramways, ramifying the whole of the important area north of the Thames. There was another important enterprise, which was becoming so large, that it would form a very important proportion of their total investments—he referred to the combination of electrical tramways and light railways in South Staffordshire, Warwickshire, and Worcestershire. They had been engaged upon that enterprise for the last six or seven years, and they had either bought up or obtained control of all the traction companies in the district. There was another very important matter he wished to touch upon, and one which he had spoken of at previous meetings, viz., that, in the opinion of the board, it was very advisable that they should have control of some manufacturing works, not only for the purpose of supplying their various associated companies with the apparatus required for establishing the undertakings, but they also required facilities for carrying out repairs and making replacements, and also for storing materials which were required for the daily operation of their various undertakings. With that object in view they had, with the approval of the shareholders, made a proposal to the shareholders of the Brush Company to exchange their shares in that company for shares in the British Electric Traction Company, and a large proportion of the shareholders had accepted the offer. They had also assisted the Brush Company with capital, and several of the directors of the Traction Company were now on the board of the Brush Company. In the opinion of the board it was desirable that the policy of merging the interests of the two companies should be proceeded with still further, and they proposed that another offer should be made of shares in the company in exchange for shares in the Brush Company upon equitable terms to be announced in due course. That naturally led him to speak of the proposed absorption of the Electrical Power Distribution Company. That company had been mainly capitalised by the British Electric Traction Company and the Brush Company jointly, and it was in a very large measure carrying on business on identical lines with that carried on by their company; although it was originally formed quite independently of either the Brush or their company, for the purpose of doing work which did not at that time fall within the scope of either companies—viz., to promote and carry out electric lighting and power schemes in various parts of the country. It appeared, however, very soon after the formation of the company, that it was in the interests of the British Electric Traction Company and of the Brush Company to support the Electrical Power Distribution Company and identify themselves with it, because the company was a large buyer of apparatus, which could be supplied by the Brush Company, and many of its lighting and electrical power schemes could be worked in very advantageously with the tramway and light railway schemes of the British Electric Traction Company. After very fully considering the question, they had come to the conclusion that it would be much more satisfactory, on all grounds, that the Electrical Power Distribution Company should be merged into the British Electric Traction Company and its various subsidiary associated companies. With regard to the increase of capital proposed, some shareholders thought they were increasing the capital account too rapidly, but he could assure them that that was not the case, and that as a matter of fact, the business was being increased very cautiously, notwithstanding that the strides they were making appeared to be rapid. Their new business was of a distinctly more profitable character, as figures relating to the profits conclusively proved. Nevertheless, they were much more concerned, for reasons of prudence, to restrict their operations than to increase them, for the real difficulty was not that of obtaining capital or business, but to obtain the services of competent men with a knowledge of the work to be done for carrying it out. That was another strong reason why they should consolidate their various interests and secure the services of men of experience exclusively for their business. The absorption of the Electrical Power Distribution Company would require about £200,000 in ordinary and preference shares, less 10,600 shares held by the British Electric Traction. He did not know how many of the new shares would be required for the exchange of shares proposed to be made to the shareholders of the Brush Company. They also proposed to distribute 20,000 shares to the present shareholders of the company, so that for all the various purposes additional share capital was required apart from any further capital that might have to be issued later on for the ordinary purposes of the business. The directors did not think there was much to be gained by making frequent applications to shareholders, and they proposed now, therefore, that the capital should at once be increased by £1,000,000 in ordinary shares and £1,000,000 in preference shares, and that would give the directors power to issue £1,000,000 in debenture stock. He had referred to the issue of 20,000 shares to the present shareholders, and they proposed that for several reasons. First, they desired that the shareholders should have what was in the nature of a bonus by those shares being allotted at par. Each shareholder would be entitled to have one new share in respect of each 10 shares he now held, and in order that the small shareholders should have their proportion of the bonus as well as the large, they were arranging to issue coupons for fractions of a share, and those could either be sold or others bought to make up the whole share. They had not thought it advisable to increase the dividend recommended for payment on the ordinary shares this year; they were proposing 9 per cent. for the year, which was the same as last year, but they had set aside to a special reserve fund £19,000 besides other reserves, which he thought he might fairly say had been done more as an act of prudence, than as an act of necessity. In view of the fact that the dividend had not been increased, the directors thought that the shareholders should have the advantage of the new issue of shares. The price of the shares in the market at present was so low that no public issue could be made, except as

to what the directors considered would be a sacrifice of premium, and if the shares had to be issued at a sacrifice, they thought it should be done in such a form that the advantage should go to the shareholders. On the last occasion he referred to a proposal under consideration for the establishment of a sinking fund on behalf of their various associated companies, and he confidently believed that by the time they met again the various parties affected would have agreed upon the constitution of a mutual sinking fund or trust scheme.

Mr. EMILE GARCKE seconded the report, which, after a short discussion, was agreed to.

Subsequently a resolution was carried increasing the capital of the company from £2,000,000 to £4,000,000, divided into 400,000 shares of £10 each by the creation of 200,000 new shares of £10 each.

Callender's Cable and Construction Company.

THE report of the directors for the year ended December 31st shows a balance at the credit of profit and loss for the year's working of £71,978, to which must be added the balance brought forward from 1900, making together £82,833. From this must be deducted interest on calls paid in advance, interest on debentures, dividend on preference shares, an appropriation of £7,134 for depreciation of plant, machinery and furniture, and of £3,000 carried to machinery renewal fund, leaving an available balance of £58,621. It is proposed to pay a dividend to the holders of ordinary shares Nos. 1 to 30,000 at the rate of 10 per cent. per annum (clear of income-tax), being 10s. per share, whereof 5s. was paid on November 1st, 1901, also a bonus of 5s. per share, and a special bonus of 5s. per share, carrying forward to next year's account £28,621. The total payment to the holders of the first 30,000 ordinary shares in respect of 1901 will, therefore, for dividend and bonus, be 20s. per share. The directors consider that the results of the past year's operations have been most satisfactory. A circular sent out with the report states that "certain differences have arisen between the company and W. T. Henley's Telegraph Works Company, Limited, as to the terms of the proposed amalgamation, which, in the opinion of both boards, render it impracticable, at any rate for the present, and the negotiations have therefore, by mutual consent, been treated as at an end."

Perth Electric Tramways (Western Australia) Co.

AT the meeting of this company held at 3, Laurence Pountney Hill, E.C., last week, Mr. E. Heasman, who presided, said that the total revenue earned last year was £60,268, representing average receipts of over £67 per mile per week. For the first 21 weeks of 1902 the average gross earnings per mile per week were over £68. The working expenses showed a satisfactory ratio to the receipts, being a little over 60 per cent. for the period under review. This ratio of expenses was applicable to different sections of comparatively short mileage. The present average ratio of working expenses for the first 21 weeks of the current year was only 52·6 per cent., and therefore as the traffic increased it was only reasonable to suppose that a greater reduction in this respect might be looked for. The growth of traffic necessitated additional rolling stock and motive power. For this purpose, and for the construction of further sections, the board had spent £102,109 on capital account during the 18 months under review. Seeing that for the first 21 weeks of the current year they were earning gross receipts at the rate of £1,074 per week, and that the average working expenses in that time amounted to 52·6 per week, they might reasonably hope to be in a position to pay the balance of the accumulated preference dividends within a short time, and for the future to pay the preference dividend regularly each year.

Prospectuses.

THE list was to close yesterday, Thursday, in an issue of 49,500 £1 shares in the Peking and North China Electrical Corporation, out of a nominal capital of £100,000 all in £1 shares. Messrs. Crompton & Co., Limited, are the managers in Peking, and technical advisers to the board in London. The company has been formed for various purposes, and particularly to take over the concessions, rights, and goodwill of the Siemens & Halske Aktien Gesellschaft, Messrs. H. Mandl & Co, and the Chinesische Elektricitäts Gesellschaft, M.B.H., who have acquired from the Imperial Chinese Government the right to establish an electric lighting station in Peking, confirmed by edict. Messrs. Crompton & Co., Limited, of London and Chelmsford, have undertaken to establish the electrical plant in Peking, as well as to appoint a competent staff there. Messrs. Crompton & Co. estimate that a completely-equipped plant, with mains, reserve parts, &c., and capable of extension as required, will cost about £25,000. Under the above licence the gradual extension of the electric system throughout the City of Peking is contemplated, and it is also proposed at once to apply for a large electrical concession in North China The offices of the company are at Salisbury House, London Wall, E C. (G. T. Frost, secretary).

Kalgoorlie Electric Power and Lighting Corporation.

THE report for the period from October 1st, 1900, to December 31st, 1901, to be submitted at the meeting on the 23rd inst., states that the contract with J. G. White & Co., Limited, electrical engineers and contractors, for the erection of a complete electrical power transmission plant will soon be completed. The time for completion of the contract was July 29th, 1902, but such excellent progress has been made that the directors were enabled to supply power to the Kalgoorlie Electric Tramway Company on May 1st. The shareholders have already been informed of the contract entered into with that company for the supply of power for ten years. The tramway was formally opened to the public on May 20th. Inquiries have been received from users of power for more than double the amount at the corporation's disposal. These are now being carefully considered by the corporation's representatives in Kalgoorlie with a view of entering into such contracts as will be most advantageous to the corporation. Further capital being necessary for subsidiary machinery, including rotary transformers, motors, hoists, pumps, &c., the directors, under the powers given to them by the articles of association, have created an issue of £50,000 6 per cent. debentures, of which a portion has been placed.

Calcutta Tramways Company.

AT an extraordinary general meeting on 12th inst., the special resolution passed on the 26th ult.—"That each of the existing £10 shares of the company be sub-divided into two shares of £5 each," was confirmed.

The CHAIRMAN said, according to the *Times*, that they had expected to have a second section opened about a month ago, but difficulties arose with the Government on technical points as to whether the guard wires were sufficient. The telegraph office was in Dalhousie Square, and the line passed close to it. The company had paid for the raising of all the telegraph lines, so that they went well over the tramway wires. The Government insisted that the guard wires, to prevent broken telegraph wires coming in contact with the company's line, should be exceptionally strong, and this had caused delay. On Thursday last week the board received a telegram informing them that the whole of the Chowringhee line had been passed. There would be less delay in regard to the other lines. Probably the whole of them would be open by the end of July. The Chowringhee line was four miles long, and was likely to get a good amount of first-class traffic. The great point was to secure additional service, and that was being obtained. The company were running 44,000 miles per week, as against 39,000 last year, and the improvement was simply the result of one new section. Respecting the issue of the new capital, there was every reason to be satisfied with what had been done.

The motion was adopted.

Electric and General Investment Company.—The directors have decided to recommend the payment of the following dividends, &c., for the year ended May 31st, 1902:—

Ordinary Shares.—A dividend of 5s. per share, of which 2s per share was paid on account in December last, leaving 3s. per share to be distributed, and a bonus of 2s. per share. The trustees for the ordinary shares reserve fund propose to distribute out of the proceeds of investments sold and dividends received 1s. per share, making a total present distribution of 6s. per share, or 30 per cent., or a total distribution of 8s. per share, or 40 per cent for the year. *Founders' Shares.*—A dividend for the year ended May 31st, 1902, of £50 per share. The trustees for the founders' shares reserve fund propose to distribute out of the proceeds of investments sold and dividends received £10 per share, making a total present distribution of £60. The above-mentioned payments will be subject to the deduction of income-tax. The dividends, if sanctioned by the shareholders, will be paid on July 3rd, 1902.

Brush Electrical Engineering Company.—It is announced that the Brush Electrical Engineering Company, Limited, have received an offer from the British Electric Traction Company, Limited, for an exchange of shares in the following proportions:—One fully-paid £10 ordinary share of the British Electric Traction Company for 10 £2 fully ordinary shares of the Brush Electrical Engineering Company. One fully-paid £10 preference share of the British Electric Traction Company, Limited, for six £2 fully-paid preference shares of the Brush Electrical Engineering Company.

Amazon Telegraph Company.—A meeting of the above company was held at Moorgate Station Chambers on Wednesday afternoon. A representative of the ELECTRICAL REVIEW was informed that it was a debenture-holders' meeting, that the proceedings were private, and that there was no report.

Stock Exchange Notices.—Application has been made to the Committee to appoint a special settling day in and to grant a quotation to:—Charing Cross and Strand Electricity Supply Corporation, Limited—40,000 "City Undertaking" 4½ per cent. cumulative preference shares of £5 each, fully paid.

Galloways, Limited.—The directors have declared an interim dividend at the rate of 5 per cent. per annum on the preference shares. Warrants in respect to this dividend and for half year's interest on the 4 per cent. first mortgage debenture stock of the company will be posted on 28th inst.

Electric Lighting and Traction Company, of Australia.—The transfer books of the £75,000 5 per cent. debenture stock will be closed from 17th inst. to 30th inst., inclusive, for the preparation of interest warrants for the half-year ending June 30th, 1902.

Thomas Parker, Limited.—The directors have resolved, subject to final audit, to declare a dividend of 10 per cent. for the year ending April 30th, 1902, and to carry the balance forward.

TRAFFIC RECEIPTS.

Blackburn Corporation Tramways.—Week ending June 13th, £710; last year, £715; decrease, £5. Total to date, £16,424; last year, £14,297; increase, £2,187. Miles open, 11¾.

Blackpool and Fleetwood Tramways.—Week ending June 14th, £471; last year, £553; decrease, £82. Total to date, £7,845; last year, £8,425; decrease, £580.

Bristol Tramways and Carriage Company.—Week ending June 13th, £4,225; last year, £4,504; decrease, £279.

British Electric Traction Company.—The following returns are issued of the undertakings of this company for the week ending June 6th:—

Company.	Amount	Comparison with corresponding week of last year.		No. of weeks.	Aggregate.		
					Amount.	Inc. or Dec.	
	£	+ £	− £		£	+ £	− £
Devonport*	451	—	—	22½	9,000	—	—
Dudley–Stourbridge	769	168	—	2?½	15,440	2,259	—
Gateshead¶	730	277	—	22½	14,860	1,254	—
Greenock-Pt. Glasgow	521	316	—	22½	9,575	5,476	—
Hartlepool	257	6	—	22½	4,787	371	—
Kidderminster ..	129	11	—	22½	2,398	51	—
Merthyr†	217	—	11	22½	4,410	—	£68
Middleton*	297	—	—	10½	3,253	—	—
Oldham–Ashton ..	559	—	24	22½	11,036	85	—
Poole‡	262	2	—	2?½	4,946	—	73
Potteries	1,518	163	—	22½	31,643	1,195	—
Southport	303	65	—	22½	4,469	1,277	—
South Staffordshire†	828	94	—	22½	16,986	503	—
Swansea	487	68	—	22½	9,597	827	—
Taunton*	78	—	—	22½	1,806	—	—
Tynemouth§	266	—	1	22½	4,816	249	—
Wolverhampton Dist.	146	96	—	22½	3,215	2,069	—

* Not in operation last year. † Partly steam. ‡ Comparison from April 5th only. § Comparison from March 18th only. ¶ Comparison from May 8th only.

Central London Railway.—Week ending June 14th, £7,000; last year, £6,240; increase, £760. Total to date, £161,8.9; last year, £148,775; increase, £13,004. Miles open, 6.

City and South London Railway.—Week ending June 15th, £2,953; last year, £1,889; increase, £1,084. Total to date (24 weeks), £71,449; last year, £47,232; increase, £24,217. Miles open, 6½; last year, 4¾.

Dover Corporation Tramways.—Week ending June 14th, £206 10s. 2½d.; last year, £217 15s. 0d.; decrease, £11 4s. 9½d. Total to date, £4,532 3s. 0½d.; last year, £4,388 10s. 6½d.; increase, £143 13s. 0d. Miles open, 3. Car miles run, 5,084; last year, 5,680. Number of cars, 11.

Dublin United Tramways Company.—Week ending June 13th:—D.U.T. Co., £3,690 4s. 6d.; D.S.D. Co, £853 3s. 2d.; total, £4,543 7s. 8d. Last year—D.U.T. Co., £3,778 15s. 5d.; D.S.D. Co, £918 9s. 5d.; total, £4,692 4s. 10d.; decrease, £148 17s. 2d. Aggregate to date, £100,961 13s. 6d.; last year, £97,331 9s. 7d.; increase, £3,630 3s. 11d. Mileage worked, 46.

East Ham Tramways.—Week ending June 14th, £387 16s. 10d.; total to date, £18,851. Car miles run, 11,872; number of cars, 25.

Liverpool Overhead Railway.—Week ending June 15th, £1,407; last year, £1,607; decrease, £200. Total to date, £34,281; last year, £37,713; decrease, £3,433. Miles open, 6 miles 57 chains.

Sunderland Corporation Tramways.—Week ending June 15th, £1,121; last year, £973; increase, £148. Total to date, £11,880; last year, £10,888; increase, £992. Miles open, 18·7.

STOCKS AND SHARES.

Wednesday Evening.

AFTER passing through a spasm of weakness upon the happily-contradicted rumour with reference to the seriousness of the King's indisposition, markets, as a whole, are hardening again. The speculative divisions lead the van of the advance, Consols being dull by reason of the number of new issues now made in their market by Corporations and Colonies. Home Railway stocks earlier in the week presented an unbroken series of falls, but with the coming of better weather, more optimistic views again prevail to the hardening of prices. Electric Lighting shares are steady, and the latest gyrations of the British Electric Traction Company have failed to cause any particular move in the values of the shares.

The features in Electrical Supply shares are a fall of 10s. in Metropolitans, and an advance of 5s. in both kinds of Brompton and Kensington. The buying of the latter has been both steady and persistent. Chelseas have recovered the dividend which was deducted last week, but the 4½ per cent. Debenture stock is marked down two points, *ex* the interest of 2¼ per cent. South London shares have yielded ¼, but there is a fair demand for St. James's and Westminsters. The new shares of the latter company are quoted at 3¾ *ex* the recently-paid dividend of 1s. 3d.

So far from the Coronation festivities helping the electrical supply companies, it is thought in the Stock Exchange that the dislocation of business caused by next week's celebrations will rather militate against their profits instead of increasing them. Untechnical members talk of the difficulty that exists for storing electric current as compared with the ease with which gas can be got ready beforehand, and it is pointed out that the two or three days' interruption to business will not be made up by the rates which some of the companies are to charge their customers on the illumination nights. So it has happened that there has not been much advance in the supply market on account of the Coronation, and the little note of warning sounded in these columns three months ago has, perhaps, been effectual in saving disappointment to those who might have been tempted to buy freely upon the vague tips circulated in some directions at the time.

Calcutta Electric Supply are a shade harder at 9, and the Tramway shares are 14¼, business being marked in them at 14⅝. It is said that both undertakings are prospering beyond expectation, and if this is true, it should lead to an appreciation in the price of the shares.

British Electric Traction Ordinary are 14 and 7, Preference 12¾—unchanged on the week. This is somewhat surprising, in view of the important news brought by the last few days. The capital of the concern has been doubled by the creation of 200,000 more shares of £10 each, thus raising the capital to the round four millions sterling, to say nothing of £600,000 Debenture stock out of an authorised amount of three-quarters of a million. Amalgamation with the Electrical Power Distribution has been agreed upon, and the Brush Electrical proprietors are offered Traction shares in exchange for their present holding. These are sweeping changes, but have induced very little extra business. Shareholders in the Electrical Power Distribution are the ones most to be congratulated over the latest card-shuffling. They paid £1 premium for their £10 shares, and got a security which was unmarketable. Now, however, in exchange for their shares, for which they paid £11, they are to receive British Electric Tractions at, say, 13¼, after allowing for the dividend and rights, thus making a clear profit of over £2 a share, not to mention the benefit of obtaining a readily marketable security for one which was almost not negotiable.

Brush shares are better upon the offer made to the shareholders, and in the House the proposal is liked better by those interested in the Brush Company than by Traction holders. Doubtless the knowledge of what was coming formed the source of inspiration in the buying of Brush shares during the last few weeks, but those who sold at the bottom will probably consider themselves injured in having less information than the insiders who bought their shares.

By the purchase of Mr. James Ross's shares in the City of Birmingham Tramway Company, the British Electric Traction has obtained a controlling interest in the former undertaking, and pourparlers are now in course for the purpose of providing Birmingham with a system of overhead trams, for a consideration, of course.

The failure of the Callender's-Henley's negotiations has come rather as a disappointment than as a surprise. Considering the flourishing position of each company, the work of settling terms was one of great difficulty; in fact, the task went beyond the wit of the boards to undertake successfully at the present time. The shares of neither company have moved this week, the 10s. fall in Callender's being exactly accounted for by the dividend deducted last account day.

Telegraph Manufacturing shares have now been removed from the Official List of Stock Exchange prices, although the name of the company still remains. British Insulated Wire are unchanged at 8. There is a good deal of business passing in India-Rubber Debenture stock at a trifle over par.

Brighton Railway securities were lowered a fraction upon the appearance of the latest electric railway scheme into Surrey, but the scare was considered unfounded, and back went "Berthas" to their previous price. North-London Railway stock—one of the steadiest in the list—is inclined to dullness at its elevated price of 162½, and the coming competition of the Great Northern and City is regarded askance by the market and stockholders alike. There is very little doing in Electric Railway stocks proper, and quotations show no change on the week.

In the telegraph and telephone market there are seven rises to set against four falls. Anglo-American stocks are unfavourably affected by the German Government subsidy of £95,500 per annum which is offered to the German Atlantic Telegraph Company for the use of two cables instead of the single line at present in use. Commercial Cable Debenture has been wanted, and its advance of a point was shared by one or two of the Eastern senior issues, which have also risen the same amount. Chili Telephone and United River Plate Telephone shares are both harder; it is understood that the support has been induced by the certainty that the treaty will be signed by both countries. West India and Panama shares are down ⅛ to 10s., although the latest volcano news is more reassuring. It is, however, feared that trade in the West Indies has received another blow, from which it will have great difficulty in recovering.

SHARE LIST OF ELECTRICAL COMPANIES.—TELEGRAPH AND TELEPHONE COMPANIES.

Present Issue.	NAME.	Stock or Share. ‡	Dividends for the last three years. 1899.	1900.	1901.	Closing Quotations June 11th.	Closing Quotation June 18th.	Business done during week ended June 18th, 1902. Highest.	Lowest.
82,300	African Direct Telegraph, 4 % Debs	100	...	...	...	99 —103	99 —103	...	...
25,000	Amazon Telegraph Co.'s shares, Nos. 1 to 25,000	10	...	...	...	3½— 4½	3½— 4½	...	...
119,700£	Amazon Telegraph 5 % Debs., Nos. 1 to 1,250 Red.	100	...	...	...	70 — 80	70 — 80	..	...
804,720	Anglo-American Telegraph	Stock	73/6	3⅛%	61s.	44 — 47	44 — 47	45½	...
3,097,640	Do. do. 6 % Pref	Stock	6 %	6 %	6 %	87 — 89	86 — 88	88	87
3,097,640	Do. do. Deferred	Stock	£1 7s.	5s.	2s.	6½— 7¼	6½— 7	6⅛	6⅜
44,000	Chili Telephone, Nos. 1 to 44,000	5	4 %	5 %	...	3½— 4	3¾— 4¼	4	...
13,333,300$	Commercial Cable	$100	8 %	...	...	165 —175	165 —175	...	...
1,741,029£	Do. do. Sterling 500 year 4 % Deb. Stock Red	Stock	..	..	...	95 — 97	96 — 98	97½	96½
16,000	Cuba Telegraph	10	7 %	..	...	4½— 5½	4½— 5½	...	...
6,000	Do. 10 % Pref.	10	...	...	...	12½— 13½	12½— 13½	...	...
12,931	Direct Spanish Telegraph	5	4 %	4 %	...	2½— 3⅛	2½— 3⅛	..	...
6,000	Do. do. 10 % Cum. Pref.	5	...	...	...	8½— 9½	8⅝— 9½	...	...
30,000£	Do. do. 4½ % Debs.	50	...	...	...	99 —102	99 —102	...	...
60,710£	Direct United States Cable	20	3½%	3½%	...	9½— 10½	9½— 10½	...	...
101,300£	Direct West India Cable, 4½ % Reg. Deb., within Nos. 1 to 1,200, Red.	100	...	...	...	99 —102	100 —103	...	...
4,000,000	Eastern Telegraph, Ord. Stock	Stock	7 %	7 %	...	120 —130	120 —130	124½	121
1,930,807	Do. 3½ % Pref. Stock	100	...	...	...	87 — 90	87 — 89	89½	88¼
1,432,268£	Do. 4 % Mort. Deb. Stock Red.	Stock	...	...	...	107 —111	107 —111	110	108
300,000	Eastern Extension, Australasia, and China Telegraph	10	7 %	7 %	7 %	12 — 13	12 — 13	12⅝	12
820,000£	Do. 4 % Deb. Stock	Stock	...	...	...	108 —113	108 —113	...	....
800,000£	Eastern and South African Telegraph, 4 % Mort. Deb. Nos. 1 to 3,000, red. 1909	100	5½%	...	...	99 —102	100 —103	...	...
200,000£	Do. 4 % Reg. Mt. Debs. (Mauritius Sub.) 1—8,000	25	...	...	...	99 —102%	99 —102 %	...	...
180,227	Globe Telegraph and Trust	10	5½%	5½%	...	8 — 9	8 — 9	8⅜	8⅝
180,042	Do. do. 6 % Pref.	10	...	...	...	12½— 13½	12½— 13½	13¼	12⅞
150,000	Great Northern Telegraph, of Copenhagen	10	..	15 %	...	25 — 27	25 — 27	...	...
75,000	Halifax and Bermuda Cable, 4½ % 1st Mort. Debs., within Nos. 1 to 1,200, Red.	100	..	...	...	99 —103	100 103	...	...
17,000	Indo-European Telegraph	25	10 %	10 %	10 %	37 — 41	37 — 41	41	...
100,000£	London Platino-Brazilian Telegraph, 6 % Debs.	100	...	...	..	100 —104	100 —104	...	..
72,680	Montevideo Telephone, Limited, Ord., Nos. 1 to 72,680	1	2½%	..	..	¼— ⅛	¼— ⅛	...	..
86,492	Do. do. do. 5 % Pref., Nos. 1 to 86,492	1	5 %	...	..	⅝— 1	⅝— 1	...	..
983,333	National Telephone, Pref. Stock	100	5 %	5 %	5 %	95 — 99	95 — 99	...	...
200,000	Do Pref. shares	2	...	3¼	3⅜	3⅛— 3⅜	3⅛— 3⅜	...	...
1,966,667	Do Def. Stock	100	...	60	64 xd	53 — 57	53 — 57	...	...
15,000	Do. 6 % Cum. 1st Pref.	10	6 %	6 %	6 %	12 — 14	12 — 14	...	..
15,000	Do. 6 % Cum. 2nd Pref.	10	6 %	6 %	6 %	12 — 14	12 — 14	...	...
250,000	Do 5 % Non-cum. 3rd Pref., 1 to 250,000	5	5 %	5 %	5 %	4⅞— 5⅛	4⅞ - 5⅛	5	5
2,000,000£	Do. 3½ % Deb. Stock Red.	Stock	3½%	3½%	3½%	94 — 97	94 — 97	96	...
500,000£	Do. 4 % Deb. Stock Red.	100	..	4 %	4 %	103 —107	103 —107	...	...
171,504	Oriental Telephone and Elec., Nos. 1 to 171,504, fully paid	1	5 %	6 %	6 %	1⅛— 1 1/16	1⅛— 1 1/16	...	...
100,000£	Pacific and European Tel., 4 % Guar. Debs., 1 to 1,000	100	...	...	...	99 —102	99 —102	...	...
11,839	Reuter's	8	5 %	5 %	...	7 — 8	6½— 7½xd	...	...
3,303	Submarine Cables Trust	Cert.	...	...	...	110 —120	110 —120	...	...
58,000	United River Plate Telephone	5	7 %	...	...	4⅝— 5¼	5 — 5⅛	...	...
40,006	Do. do. 5 % Cum. pref. Nos. 1—40,000	5	...	...	...	4½— 5	4⅝— 5¼	...	...
179,947£	Do. do. 5 % Debs.	Stock	..	...	...	103 —106	103 —106	..	...
155,600	West African Telegraph, 5 % Debs.	100	...	...	...	99 —102	99 —102	...	...
30,008	West Coast of America, Nos. 1—30,000 and 53,001—53,008	2½	...	...	...	⅛— ⅜	⅛— ⅜	...	..
150,000£	Do. do. 4 % Debs., 1—1,500 gua. by Bras. Sub. Tel.	100	...	...	...	99 —102	99 —102	...	...
207,930	Western Telegraph, Ltd., Nos. 1—207,930	10	7 %	7 %	...	11½— 12½	11⅞— 12½	12⅛	...
75,000£	Do do. 5 % Debs. 2nd series, 1905	100	...	...	...	102 —105	102 105	102	...
348,777£	Do. do. 4 % Deb. Stock Red.	100	...	...	...	99 —102	99 —102	101½	...
88,321	West India and Panama Telegraph	10	8%	...	...	⅛— ¼	⅜— ⅝	...	.
34,563	Do. do. do. 6 % Cum. 1st Pref.	10	...	...	...	5¼ - 5½	5¼ - 5½	...	...
4,669	Do. do. do 6 % Cum. 2nd Pref.	10	...	...	...	3½ - 4½	3½ - 4½	...	...
80,000£	Do do do 5 % Debs., Nos. 1 to 1,800	100	..	..	...	101 —104	101 —104	..	...

ELECTRICITY SUPPLY COMPANIES.

100,000	Blackheath and Greenwich Dist. Electric Light, Ord.	1	...	...	...	¼— ⅜	¼— ⅜	..	...
100,000	Do. 4½ % 1st Deb. Stock, Prov. Certs.	100	...	...	...	100 —104	100 —104	...	...
19,661	Brompton & Kensington Elec. Lt. Sup., Ord., 101 to 19,761	5	6 %	6 %	8 %	8⅜— 9¼	9 — 9½	...	...
20,000	Do. do. 7 % Cum. Pref.	5	...	...	..	8⅜— 9¼	9 — 9½	9⅜	...
50,000	Charing Cross and Strand Electricity Supply	5	9 %	9 %	10 %	9 — 10	9 — 10	9⅜	9 5/16
50,000	Do. do. do. do. 4½% Cum. Pref.	5	...	...	...	5¼— 5⅜	5¼— 5⅜	5½	5 7/16
250,000	Do. do. do. 4% Deb. Stock Red.	100	...	...	...	105 —107	105 —107	106¾	...
34,000	*Chelsea Electricity Supply, Ord.	5	6 %	5¼%	4 %	5 — 5¼	5 — 5¼xd	5⅜	...
150,000£	Do. do. do. % Deb. Stock Red.	Stock	...	...	...	110 —113	108 —111	...	...
70,579	City of London Electric Lighting, Ord. 40,001—110,579	10	4 %	0 %	5 %	8 — 9	8 — 9	8⅜	...
40,000	Do. 6 % Cum. Pref., 1 to 40,000	10	6 %	6 %	...	11½— 12½	11½— 12½	12 3/16	...
400,000£	Do. 5 % Deb. Stock, Scrip. (iss. at £115) all paid	...	...	...	...	123 —128	123 —128	...	...
200,000	Do. 4½% 2nd Deb. Stock, Prov. Certs., all paid	100	...	...	...	103 —106	103 —106	...	...
40,000	County of Lond. & Brush Prov. Elec. Ltg., Ord. 1—40,000	10	4 %	4 %	4 %	7½— 8¼	7½— 8½	...	...
20,000	Do. do. do. 6 % Pref., 40,001—60,000	10	6 %	6 %	...	12 — 13	12 — 13	13	...
400,000£	Do. 4½ % Deb. Stock, Prov. Certs (all paid) Red.	...	...	...	...	108 —111	109 —112	111	110¾
35,500	Edmundson's Elec. Corp., Ord. Shares	5	6 %	7 %	...	6½— 6¾	6½— 6¾	6⅝	...
20,000	Do. do. 6 % Cum. Pref.	...	...	...	...	5¾— 6¼	5¾— 6¼	...	...
120,000£	Do. do. 4½ % 1st Mort. Deb. Stock.	100	...	...	...	108 —111	108 —111	...	...
21,000	Kensington and Knightsbridge Electric, Ord.	5	11%	12%	10%	10 — 11	10 — 11	...	...
90,000	Do. do. do. 4 % Deb. Stock	Stock	...	...	...	101 —104	101 —104	...	...
110,000	London Electric Supply Corporation, Limited, Ord.	3	...	...	...	1½— 1⅝	1½— 1⅝	...	...
49,840	Do. do. do. do. 6 % Pref.	5	...	...	...	4 — 4½	4 — 4½	...	...
250,000£	Do. do. do. do. 4% 1st Mt. Db. Stock Rd.	Stock	...	...	...	95 —100	94 — 99xd	96½	...
98,769	Metropolitan Electric Supply, 101 to 62,500	10	5 %	6 %	6¼%	16½— 17½	16 — 19	16⅝	16½
220,000£	Do. 4½% First Mortgage Debenture Stock	...	...	...	...	111 —115	111 —115	...	...
250,000£	Do. 3½% Mort. Deb. Stock Red.	Stock	...	...	...	98 —101	98 —101	100½	99½
8,652	Notting Hill Electric Lighting	10	7 %	7 %	6 %	14 — 15	14 — 15	14¼	...
40,000	St. James's and Pall Mall Electric Light, Ord.	5	14½%	14½%	14½%	14½— 15½	14½— 15½	15½	15 3/16
20,000	Do. do. 7 % Pref., 20,081 to 40,080	5	7 %	7 %	7 %	8½— 9½	8½— 9½	8⅝	...
150,000£	Do. do. 3½ % Deb. Stock Red.	100	...	...	...	98 —101	98 —101	...	...
12,000	Smithfield Market Elect. Supply, Ord.	5	..	...	...	1⅞— 2¼	1⅞— 2¼	...	...
50,000£	Do. do. 4 % Deb.	100	...	...	...	80 — 90	80 — 90	...	...
55,000	South London Electricity Supply, Ord.	5	...	...	...	3 — 3½	2⅝— 3¼	3	...
109,518	Westminster Electric Supply, Ord.	5	13 %	10½ %	10½%	11 — 12	11 — 12	11⅝	11 5/8

* Subject to Founders Shares. † Quotations on Liverpool Stock Exchange.
‡ Unless otherwise stated all shares are fully paid. ‖ Dividends paid in deferred share warrants, profits being used as capital.
Dividends marked § are for a year, consisting of the latter part of one year and the first part of the next.

SHARE LIST OF ELECTRICAL COMPANIES.—*Continued.*

ELECTRICAL RAILWAY, MANUFACTURING, AND INDUSTRIAL COMPANIES.

Present Issue.	NAME.	Stock or Share.	Dividends for the last three years. 1899.	1900.	1901.	Closing Quotation June 11th.	Closing Quotation June 18th.	Business done week ended June 18th, 1902 Highest.	Lowest.
20,000	British Aluminium 7 % Cum. Pref.	‡ 10	...	...	...	4½ - 5½	4½ — 5½	...	...
300,000*l*	Do. do. 5 % 1st Mort. Deb. Stock Red. ...	Stock	...	...	...	86 — 90	86 - 90	...	...
62,074	British Electric Traction	10	8 %	9 %	9 %	13½ 14½	13½ — 14½	14½	14
90,000	Do. do. 6 % Cum. Pref.	10	...	...	...	12½ - 13	12½ - 13	12 11/16	...
600,000*l*	Do. do. 5 % Perpetual Debenture Stock ...	Stock	...	...	..	124 —127	124 —127	126	124½
70,000	British Insulated Wire Ord.	5	20 %	15 %	10 %	7½ — 8½	7½ 8½	...	...
70,000	Do. do. 6 % Cum. Pref.	5	...	...	...	5½ 6	5½ — 6	...	...
50,000	¶Browett, Lindley & Co. (1899), Ord.	£1	...	8 %	.	13s. to 15s.	13s. to 15s.	...	...
50,000	¶ „ „ „ 6 % Cum. Pref.	£1	...	6 %	.	16/6 to 17/0	16/6 to 17/0	...	...
105,731	Brush Elecl. Enging., Ord., 1 to 105,731	2	5½%	5 %	Nil	⅜— 1½	1½ - 1⅝	...	...
150,000	Do. do. Non-cum. 6 % Pref.	2	6 %	6 %	3 %	1¾ - 2¼	1⅞— 2¼	...	...
125,000*l*	Do. do. 4½ % Perp. Deb. Stock	Stock	...	..	...	101 —104	101 —104	...	...
125,000*l*	Do. do. 4½ % Perp. 2nd Deb. Stock ...	Stock	...	..	...	95 —100	95 —100	...	...
30,000	Callender's Cable Construction shares, Nos. 1—30,000 ...	5	15 %	15 %	20 %	17 - 18	16 - 17 xd	...	...
40,000	Do. do. 5 % Cum. Pref.	5	...	..	..	5⅜ 6¼	5⅜ - 6¼	...	...
90,000*l*	Do. do. 4½ % 1st Mort. Deb. Stock Red ...	Stock	...	..	...	111 115	111 —115	...	...
1,969,800	Central London Railway, Ord. Stock	Stock	...	...	4 %	104 107	104 —107	106¼	105½
440,100	Do. do. 4 % Pref. Stock	Stock	...	..	4 %	103 - 106	103 —106	...	...
440,100	Do. do. Def. do.	Stock	...	...	4 %	100 — 103	100 —103	102	...
855,000	City and South London Railway	Stock	1⅞%	1½%	2 %	71 — 74	71 — 74	71	...
54,000	Crompton & Co., Nos. 1 to 54,000	3	7½%	8 %	...	3 — 3½	3 — 3½	...	...
100,000*l*	Do. 5 % 1st Mort. Reg. Debs., 1 to 900 of £100, and 901 to 11,000 of £50 red	...	...	...	..	103 —108 %	103 —108 %	...	...
99,261	Edison & Swan Utd. El. Lgt., "A" shares, £3 pd. 1 to 99,261	5	6 %	2½%	...	⅛— ⅜	⅛— ⅜	...	...
17,139	Do. do. do. "A" Shares, 01—017,139 ...	5	6 %	2½%	...	1½ - 2½	1½ - 2½	...	...
344,023*l*	Do. do. do. 4 % Deb. Stock Red ...	100	...	...	...	75 - 80	75 — 80	...	...
100,000*l*	Do. do. 5% 2nd Deb. Stock Prov. Certs. all pd.	100	...	...	...	82 — 87	82 — 87	...	...
112,100	Electric Construction, 1 to 112,100	2	6 %	6 %	...	1⅛— 1⅜	1⅛— 1⅜	...	...
31,390	Do. do. 7 % Cum. Pref., 1 to 31,390... ...	2	...	...	...	2½— 3	2½— 3	...	...
182,500*l*	Do. do. 4 % Perp. 1st Mort. Deb. Stock ...	Stock	...	...	...	99 —102	97 —101	...	...
18,000	General Elec. Co. (1900) 5 % Cum. Pref.	10	...	...	...	10 — 10½	10 — 10½	...	...
150,000	Do. do. 4 % Mort. Deb.	Stock	...	...	...	98 — 101	98 —101	...	...
35,000	Henley's (W. T.) Telegraph Works, Ord.	5	15 %	20 %	20 %	16½ - 17½	16½ - 17½	16⅝	...
35,000	Do. do. do. 4½ % Pref.	5	4½%	4½%	...	5½— 6	5½— 6	5 9/16	5½
50,000*l*	Do. do. do. 4½ Mort. Deb. Stock...	Stock	...	...	...	111 —115	111 —115	...	..
50,000	India-Rubber, Gutta-Percha and Telegraph Works ...	10	10 %	10 %	...	21 - 22	21 — 22	21⅜	21¼
300,000*l*	Do. do. do. 4 % 1st Mort. Deb	100	...	...	...	99 —102	99 —102	10 ¾	..
37,500	†Liverpool Overhead Railway, Ord.	10	3¾%	3¼%	1½%	4 1/16 - 4 1/8	4 1/16 — 4 1/8	...	..
10,000	† Do. do. Pref., £10 paid	10	5	...	...	10½ - 11	10½ — 11	...	..
7,500	Parker (Thomas), Limited, Ord., Nos. 1 to 7,500	10	...	...	...	15½ - 16½	15½— 16½	...	...
	§Rosling, Appleby & Fynn 6 % Cum. Pref.	£1	...	6 %	...	19/0 to 20/0	... — ..	...	
37,350	Telegraph Construction and Maintenance	12	15 %	17½%	20 %	34 - 37	34 — 37	36	35
150,000*l*	Do. 4 % Deb. Bds. Nos. 1 to 1,500 Red. 1909 ...	100	...%	...	...	103 —106	103 —106	...	..
25,000	Telegraph Manufacturing, Ord. Nos. 1 to 25,000	5	12 %	12 %	...	9½ - 10½	9½— 10½	...	...
20,000	Do. do. 5 % Cm. Prf. Nos. 1 to 20,000...	5	...	...	...	5½— 6	5½— 6	...	
540,000*l*	Waterloo and City Railway, Ord. Stock	100	3 %	3 %	3 %	93 - 96	93 — 96	94	92½

† Quotations on Liverpool Stock Exchange. ‡ Unless otherwise stated all shares are fully paid. § From Bradford Share List.

LATEST PROCURABLE QUOTATIONS OF SECURITIES NOT OFFICIALLY QUOTED.

Consolidated Telephone Construction and Maintenance, ⅞—1⅛.
National Electric Free Wiring, —1.

Oldham, Ashton, and Hyde Electric (£10 pd.), Ord., 14½—15
Do. do. Pref. (£10 pd.), 10⅞—10⅝.

* From Birmingham Share List. ¶ From Manchester Share List.

Bank rate of discount 3 per cent (February 6th, 1902).

MARKET QUOTATIONS, Wednesday, June 18th.

CHEMICALS, &c.		This week.	Last week.	Inc. or Dec.
a Acid, Hydrochloric	per cwt.	5/-	5/-	..
a „ Nitric	per cwt.	22/-	22/-	..
a „ Oxalic	per cwt.	82/-	82/-	..
a „ Sulphuric	per cwt.	5/6	5/6	..
a Ammoniac, Sal	per cwt.	42/-	42/-	..
a Ammonia, Muriate (crystal) ..	per ton	£88 10	£88 10	..
a „ „ „ ..	per ton	£90	£90	..
a Bleaching powder	per ton	£7	£7	..
a Bisulphide of Carbon	per ton	£15	£15	..
a Borax	per ton	£18	£18	..
a Benzole (90 %)	per gal.	7/-	7/-	..
a „ (50/90%)	per gal.	5/6	5/6	..
a Copper Sulphate	per ton	£19	£19	..
a Lead, Nitrate	per ton	£24	£24	..
a „ White Sugar	per ton	£31	£31	..
a „ Peroxide	per ton	£27 10	£27 10	..
a Methylated Spirit	per gal	2/6	2/6	..
a Naphtha, Solvent (90% at 160° C).	per gal.	5/6	5/6	..
a Potash, Bichromate, in casks..	per lb.	8d.	8d.	..
a „ Caustic (75/80%) ..	per ton	£24	£24	..
a „ Bisulphate	per ton	£85	£85	..
a Shellac	per cwt.	110/-	110/-	..
a Sulphate of Magnesia	per ton	£4 10	£4 10	..
a Sulphur, Sublimed Flowers ..	per ton	£8 5	£8 5	..
a „ Recovered	per ton	£5 10	£5 10	..
a „ Lump	per ton	£5	£5	..
a Soda, Caustic (white 70 %) ..	per ton	£10 15	£10 15	..
a „ Crystals	per ton	£8	£8	..
a Bichromate, casks ..	per lb	2¼d.	2¼d.	..

METALS, &c.				
b Aluminium Ingots, in ton lots	per ton	£148	£148	..
b „ Wire, in ton lots	per ton	£224	£224	..
b „ Sheet, in ton lots	per ton	£191	£191	..
p Babbitt's metal ingots.. ..	per ton	£40 to £120	£40 to £120	..
c Brass (rolled metal 9" to 12") basis	per lb.	6¾d.	6¾d.	..
c Tube (brazed)	per lb.	8¼d.	8¼d.	..
c „ „ (solid drawn) ..	per lb.	7d.	7d.	..
c „ Wire, basis	per lb.	7d.	7d.	..
c Copper Tubes (brazed) ..	per lb.	8¾d.	8¾d.	..
c „ „ (solid drawn) ..	per lb.	9d.	9d.	..
g Copper Bars (best selected) ..	per ton	£69	£69	..

METALS, &c. (*continued.*)		This week	Last week.	Inc. or Dec.
g Copper Sheet	per ton	£69	£69	..
g „ Rod	per ton	£69	£69	..
e „ (Electrolytic) Bars ..	per ton	£63	£63	..
e „ „ Sheets ..	per ton	£75	£75	..
e „ „ Rod	per ton	£68	£68	..
e „ „ H.C. Wire	per lb.	8d.	8d.	..
f Ebonite Rod	per lb.	8/-	8/-	..
f „ Sheet	per lb.	5/-	5/-	..
a German Silver Wire	per lb.	1/5	1/5	..
h Gutta-percha fine	per lb.	8/-	8/-	..
h India-rubber, Para fine	per lb.	2/11½	2/11½ to 3/0½	dec.
i Iron, Charcoal Sheets	per ton	£18	£18	..
i „ Pig (Cleveland warrants) ..	per ton	49.8	49/9	1d. dec.
i „ Forgings, according to size	per ton	From £11	From £11	..
i „ Scrap, heavy	per ton	47/6 to 50/-	47/6 to 50/-	..
i „ Wire, galvanised No. 8 ..	per ton	£9 15	£9 15	..
g Lead, English Ingot	per ton	£11 7 6 to £11 10	£11 10	dec.
g „ „ Sheet	per ton	£13	£13	..
m Manganin Wire No. 28	per lb.	8/-	8/-	..
g Mercury	per bot.	£8 15	£8 15	..
d Mica (in original cases), small ..	per lb.	8d. to 9d.	8d. to 9d.	..
d „ „ „ medium	per lb.	1/9 to 2/9	1/9 to 2/9	..
d „ „ „ large ..	per lb.	8/8 to 7/8	8/8 to 7/8	..
p Phosphor Bronze, plain castings	per lb.	11½d. to 1/2	11½d. to 1/2	..
p „ rolled bars & rods	per lb.	1/- to 1/8	1/- to 1/8	..
p „ „ strip & sheet	per lb.	From 1/2	From 1/2	..
c Platinum	per oz.	£4 1	£4 1	..
p Silicium Bronze Wire	per lb.	9d. to 1/-	9d. to 1/-	..
i Steel, Magnet, acc'd'ng to desc'p'n	per ton	From £15 to £40	From £15 to £40	..
i „ „ in bars		£58	£58	..
g Tin, block	per ton	£127 to £129	£132 to £133	£4 to £5 dec.
g „ foil	per lb.	1/6	1/6	..
n „ wire, Nos. 1 to 15	per lb.	1/8	1/8	..
p White Anti-friction Metals —				
"White Ans" brand	per ton	£36 to £60	£35 to £65	..
j Yarns, 2/10s Grey Cotton, on sp'ls	per lb.	7d.	7d.	..
j „ 6 len. Flax	per lb.	5¾d.	5¾d.	..
j „ 3 ply 10 lbs. Russian ..	per lb.	4 1/16d.	5 1/16d.	..
j „ 10 lbs. Russian, single ..	per lb.	4¼d.	4¼d.	..
j „ 180 lbs. Jute rove	per ton	£10 2 6	£10 2 6	..
k Zinc, Sh'ts, (Vieille Montagne bnd.)	per ton	£22 10	£22 10	..

Quotations supplied by { a Messrs. G. Boor & Co. b The British Aluminium Co., Ltd. c Messrs. Thos. Bolton & Sons. d Messrs. F. Wiggins & Sons. e Messrs. Frederick Smith & Co.

Quotations supplied by { f India-Rubber, G.-P. and Teleg. Works Co., Ltd. g Messrs. James & Shakspeare. h Messrs. Edward Till & Co. i Messrs. Bolling & Lowe. j Messrs. Walter H. Hindley & Co.

Quotations supplied by { k Messrs. Morris Ashby, Limited. m Messrs. W. T. Glover & Co., Ltd. n Messrs. P. Ormiston & Sons. o Messrs. Johnson, Matthey & Co., Ltd. p The Phosphor Bronze Company, Ltd.

INSTITUTION OF ELECTRICAL ENGINEERS.

SOME NOTES ON POLYPHASE MACHINERY.

By A. C. Eborall.

(*Paper read at Manchester, March 25th*, 1902.)

(*Concluded from page* 998.)

The general arrangement of the latter motor is shown in fig. 20 from which the arrangement of the (liquid) starting resistance can also be seen; this latter is interlocked with the brush-gear in such a manner that when the resistance is all out, the motor thus being at full speed, a few more turns of the resistance handle causes the rings to be short-circuited by an internal clutch, and the brushes to be raised, as previously described.

From the test curves given in fig. 19, and from the data of the two motors in question, a comparison of the two motors can be readily made, as set forth in the table below:—

Normal rating of motor.	350 B.H.P.	115 B.H.P.
No load speed	315	210
Frequency	21	42
Terminal pressure	500	250
Full load current per phase... ...	373	289
„ efficiency	93 %	87 %
„ power factor	90 %	79 %
„ slip...	1·5 %	3 %
Maximum load before falling out of step (B H.P.)	850	230
Net weight of motor (lbs.)	19,400	14,150
Net over-all dimensions (D × L) ...	(78 × 29) in.	(92 × 17·4) in.

The above table shows at a glance that not only is the 21-cycle motor lighter and cheaper when considered on the same basis of output and speed, but it is far and away a better motor; its power factor, efficiency, slip, and overload capacity are all far superior to the 42-cycle motor. These differences are not due to the fact that the low-frequency motor is much the larger—this would make but little difference. The differences are almost entirely due to the abnormal number of poles necessary with the 42-motor, in order to bring down its speed to the value required by the pump; this motor has 24 stator poles, while the 21-motor has only 8 poles. The result is a heavy stator core of large diameter, relatively large iron loss, considerable leakage from pole to pole along the air-gap, and a considerable lower saturation of the teeth than is desirable in such a motor. For these reasons three-phase pumping and similar plants, in which slow speeds for the motors are essential, should be laid out, whenever possible, on the basis of a low frequency such as 25 cycles.

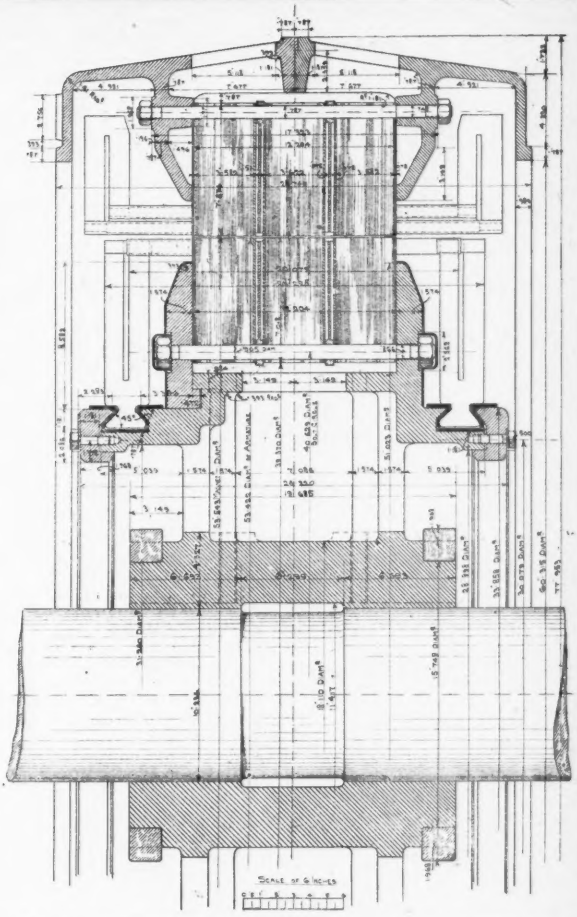


Fig. 21.—Section through Stator and Rotor of 350-B.H.P. Three-Phase Induction Motor. (Kolben & Co, Ltd.)

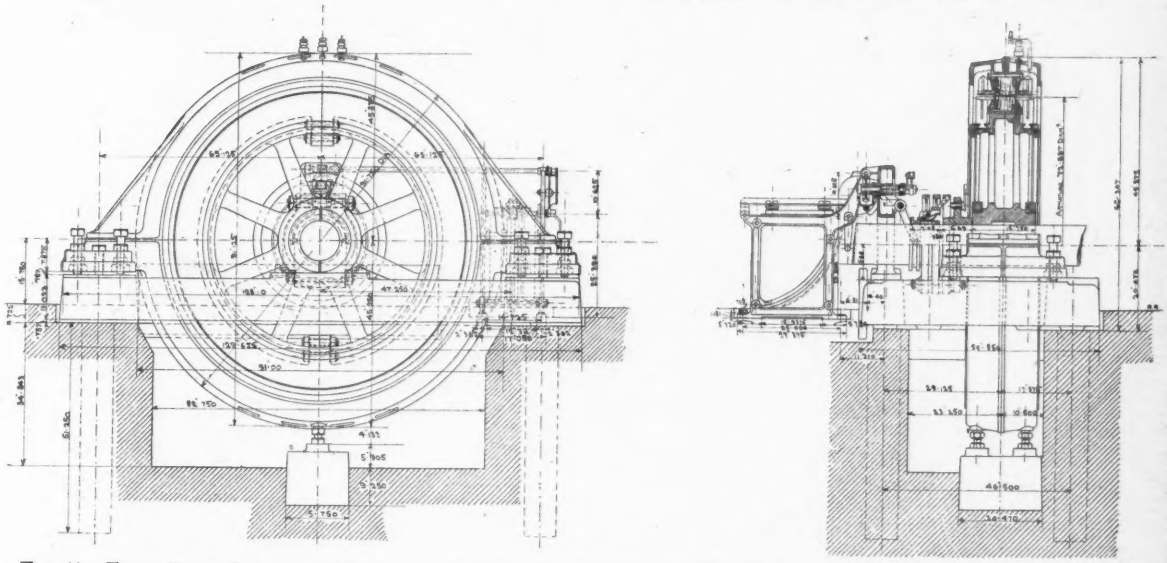


Fig. 20.—Three-Phase Induction Motor with Starting Gear for Direct Coupling to a High Speed Pump. 115 B.H.P.; 265 r.p.m.; 250 volts, 42 cycles, 24 poles. (Built by Kolben & Co., Ltd.)

The 115-B.H.P. 42-motor referred to above has the following data relative to the design:—

Schedule V.—*Three-phase Induction Motor of* 115 *B.H.P.*

(See figs. 19B and 20.)

Stator:—	
Diameter of bore	73 in.
Total number of slots...	216
Number of conductors in series per slot	2
Diameter of conductor, bare	0·454 in.
„ „ insulated	0·59 „
Nature of winding	Star connected bar.
Rotor:—	
Finished diameter	72·882 in.
Total number of slots	480
Total number of conductors per slot...	1
Dimensions of conductor, bare	(0·83 × 0·236) in.
„ „ insulated	(0·91 × 0·335) in.
Nature of winding	Star connected bar.

A fully dimensioned section of the stator and rotor cores and windings of the 350 B.H.P. 8-pole motor is given in fig. 21, from which all the necessary constructional data can be obtained.

AUTOMATIC RELAY TRANSLATION FOR LONG SUBMARINE CABLES.

By S. G. Brown.

(*Paper read in London, May 1st*, 1902.)

(*Concluded from page* 999.)

In place of the interpolator, an "automatic perforator" (see Plate 3) may be employed. The automatic perforator is constructed very much like the interpolator, with this difference, that

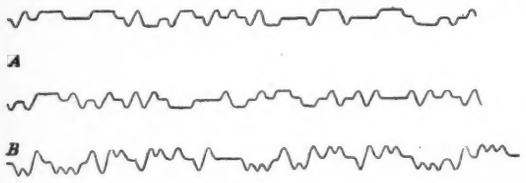


Fig. 4.

in place of two there are three clutches adapted to operate punches, by means of cams, for perforating the signals on a paper tape, such as is employed when using the automatic transmitter. To prevent waste of paper, a stopping device is brought into action after the machine has fed out, say, 5 in. of blank strip—this after the last signal has been received. The perforator reproduces on punched tape a facsimile of the message on the punched tape used at the originating station, and the copy is immediately available for sending on by the usual automatic transmitter. By the use of this auto-perforator it is possible for a single short cable to feed two long ones, or *vice versâ*, with a minimum of delay.

In order that slight failures in the relay apparatus may be instantly seen, it is necessary to have two local registers at the transmitting station, one showing the drum and tongue contacts, the other the signals actually sent into the second cable. The register for showing the drum and tongue contacts of the cable relay has been found to be most valuable and efficient, and automatic translation cannot very well be maintained without it, for it gives a record of what takes place in the most delicate part of the apparatus undisguised by defects of the Post Office relays, or the defects and corrective effects of the interpolator.

Such a record is seen in Slip *A* of fig. 4. These signals were recorded by a direct writer, worked straight off the drum cable relay. It shows the quality of the contact, and gives an outline of the signals as they arrange themselves on the drum when everything is in correct adjustment. By observing such a record, the relay may be kept in adjustment and faults in transmission easily detected.

Slip *A* is a record of signals received from a cable relay direct at 140 letters per minute over a duplexed cable of 3·2 K R under actual traffic conditions. It will be observed that there are no "beats" on the signals when the same follow each other on the same side of the line, the tongue of the relay having held over in these cases without breaking contact.

On the other hand, Slip *B* shows signals recorded by a direct writer worked off local circuit with the interpolator. Here we have all the signals clearly recorded. Such a record was received from a relay over a cable of 2·8 K R, simplex working, at 110 letters per minute under actual traffic conditions.

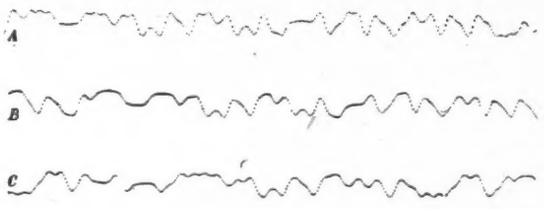


Fig. 5.

In fig. 5, Slips *A* and *B* show records of signals received on the drum cable relay apparatus, worked from a duplexed cable of 2·8 K R at 150 letters per minute; the sending battery was 60 volts. The signals were translated by the relay apparatus through an artificial line of 3·5 K R, the signals being written by a siphon recorder.

Slip *A* shows signals as received on the siphon recorder when an automatic transmitter was used at the originating station; the message was sent on from the relay by a "curb" interpolator.

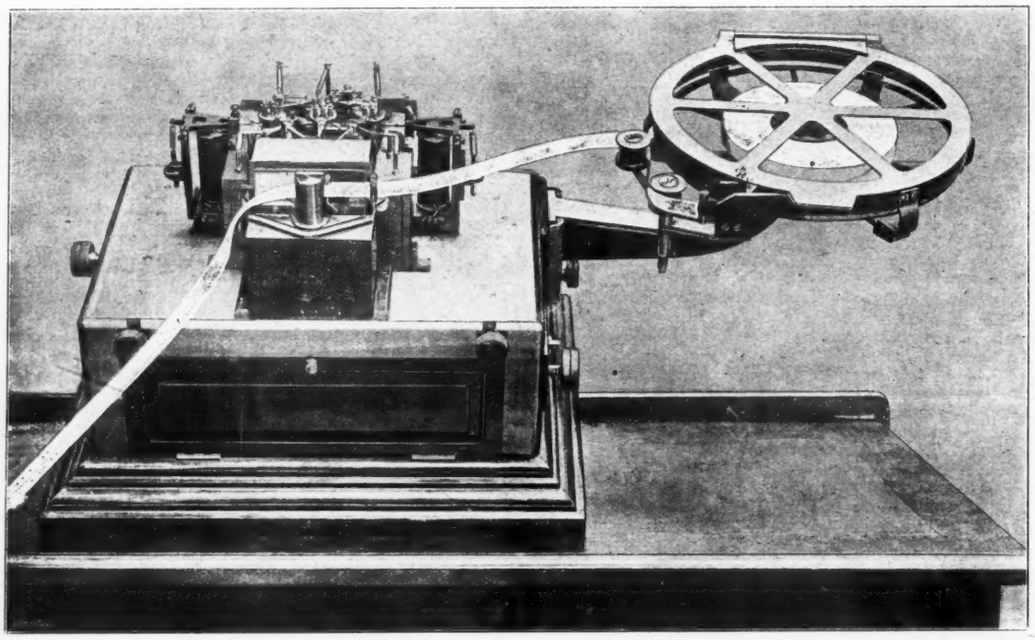


Plate 3.—Automatic Perforator.

Slip *B* shows signals as received when a couple of sounders were joined up like a hand-key, to be worked by the relay in place of the interpolator. Slip *C* shows signals transmitted under similar

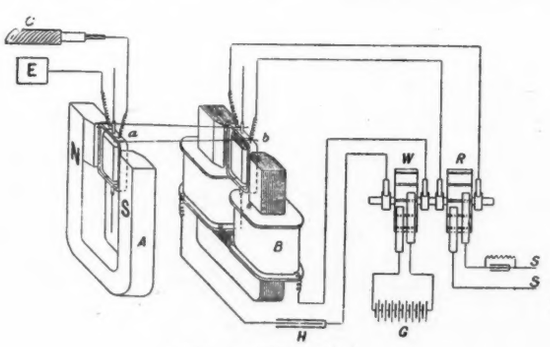


Fig. 6.—(See plate 4.)

conditions as Slip *B*, but a hand-key was used in place of the automatic transmitter at the originating station.

Having finished the description of the cable relay translation

apparatus, I wish now to describe briefly the "magnifying relay," a relay that was the forerunner of the "drum cable relay." I invented the "magnifying relay" in the year 1898. It is not at present employed on any of the cables, but I know no reason why it should not be of great use to the cable companies in the future.

As shown in fig. 6, the instrument consists of a permanent magnet, or direct-current electro-magnet A, and of an alternating electro-magnet B. In the field of the magnet A is suspended a "recorder" coil *a*, say, of abou t 500 ohms resistance; in the field of the alternating-current magnet B is suspended another and similar "recorder" coil *b*. The suspended coils *a* and *b* are coupled together by silk fibres, as is shown in the drawing. The arrival current from the cable C flows through the coil *a* to the earth-plate E, causing the coil to move, and as the suspended coil *b* is joined to it by the fibres, *b* will follow the motion of *a*. G is an electric battery. W is a current reverser that turns the direct current from G into an alternating one. H is a condenser of suitable capacity, placed in the circuit so as to neutralise the self-induction, and stop sparking at the current reverser W.

If W is revolved at a proper speed, the magnetic lines of force will be moving in and out of the iron of the magnet B, say, at a periodicity of 100 ~, threading through the suspended coil *b*, when it is at all moved out of its normal or neutral position, and inducing a voltage proportional to the angle, or more correctly, perhaps, to the sine of the angle of deflection. By these means energy may be generated in the coil *b*, which may be hundreds of times greater than that employed to move the coil, this greater energy increasing and diminishing in exact proportion to the rise and fall of the controlling current. I should compare this action, if I may be allowed the license, to a driver directing the energies of a horse by a pair of reins. R is a rectifier revolving on the same shaft as the current reverser, so as to turn the alternating current induced in the suspended coil *b* into a direct or unidirectional current, in order that it may operate a "siphon recorder," "direct-writing recorder," or any other suitable instrument, as the case may be, the instrument being placed in circuit with the lead S S.

If the circuit of the coil *b*, that hangs in the alternating-current field, possesses only resistance, the induced current will produce no disturbance on the period of the coils, or on the sensitiveness of the suspension.

To explain this, in fig. 7 I have drawn theoretical diagrams representing sine wave curves. I is the curve of magnetic induction, A the curve of induced volts, which is, as is well known, at right angles to the curve of magnetic induction, and B is the current curve, which flowing in a circuit of plain resistance, would be exactly in phase with the induced volts. This being so, the amperes, as a whole, will produce no reaction on the alternating

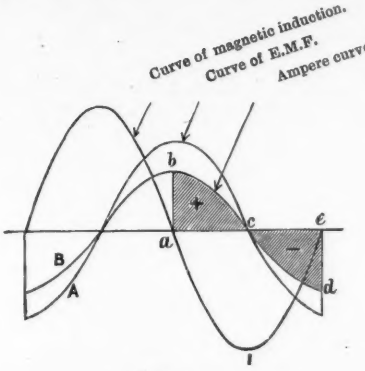


Fig. 7.

field *a* I *e*, because, as is seen, the portion *a b c* is exactly equal to, opposed, and neutralised by, the portion *c d e*. But it is otherwise, if there is capacity, because then the amperes will be accelerated, this acceleration being due to two E.M.F.s impressed on the circuit, one due to the moving magnetic lines, and the other to the voltage stored up in the condenser, the portion *a b c* being less than that part of the curve *c d e*, the difference acting on the magnetism so as to cause the coil *b* to move out of the field. If there is inductance, the contrary action will take place, in which case, the part *a b c* being greater than the part *c d e*, the coil will then endeavour to remain in the field opposing the action to move t out.

Capacity has the same effect as slackening the control of the suspensions, increasing the period of the coils and making the instrument more sensitive, while induction stiffens up the coil reducing the period. This being so, a ready means for adjustment is provided for by plugging in induction or capacity, the control over the coils may be instantly increased or lowered, and this is so, whatever may have been the initial mechanical control, within reason.

I have arranged the instrument, on some occasions, to work with only one suspended coil, combining the alternating and direct currents on one field magnet, the current from the cable passing

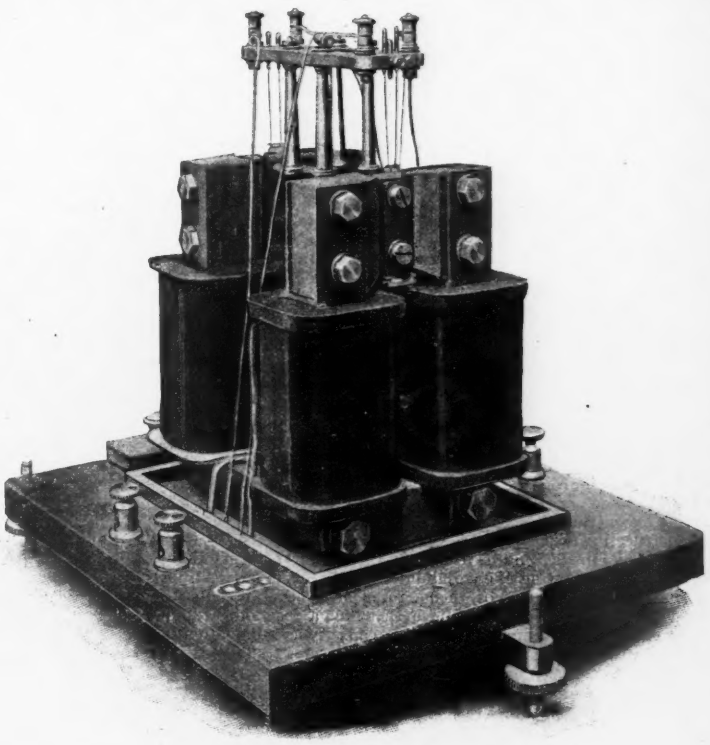


Plate 4.—Magnifying Relay.

through a choking coil before flowing round the suspended coil. The choking coil stops the induced alternating current from flowing into the cable, while the current from the cable is blocked, say, by a condenser, from flowing past the rectifier and wasting its energy in the local circuit. Such a single-coil instrument acts as well as a double-coil one, but I do not know if it possesses any special advantage except on the score of mechanical simplicity.

On trial with the magnifying relay over an artificial cable, I have

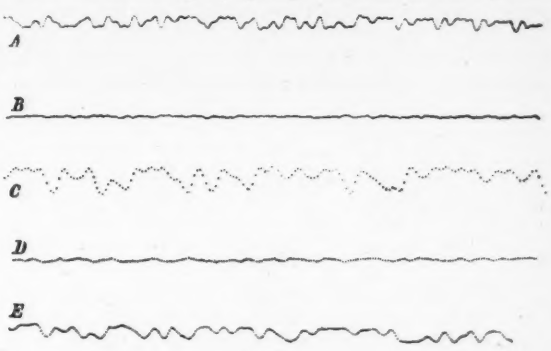


Fig. 8.

obtained some rather interesting results. For instance, the Slip *A* in fig. 8 shows signals written by a siphon recorder, worked by a "magnifying relay." The "magnifying relay" acts as a receiver at the end of an artificial line of 7,000 ohms resistance and 310 microfarads capacity. An automatic "curb" transmitter was used as sender, the speed being 150 letters per minute, the sending battery having a potential of only 3 volts. Slip *B* shows the signals received under identical conditions, but with the "magnifying relay" cut out of circuit, the siphon recorder acting as receiver direct. Again, the Slip *C* shows signals written by a siphon recorder worked off a "magnifying relay," while Slip ' shows the signals as received by the siphon recorder direct, the relay being cut out of circuit. The currents were transmitted by an automatic "curb" transmitter at 185 letters per

minute, with a sending battery of 50 volts, the KR of the line being 3·6.

Slip E shows signals received at a fairly high speed, the siphon recorder being worked off the induced currents of the "magnifying relay," as in slips A and C; the artificial line had a retardation of 3·6 KR, the automatic "curb" transmitter was sending with a battery of 42 volts, the speed of signalling was at the rate of 280 letters per minute.

When signals at a moderate speed were being received on the particular magnifying relay used in these experiments, it was difficult to detect by the eye any motion whatever in either of the suspended coils when observed through a strong magnifying glass. Though small in amplitude, it is certain that the motion occurred from the fact that the currents induced thereby were sufficient to cause large and very visible movements in the signalling coil of the siphon recorder.

The "magnifying relay" seems to possess three main points of advantage for cable working:—

1. It may be used to work the siphon recorder with the signals of the same size, and at the same speed as at present, but with greatly reduced sending battery power.

2. It may be used to work the siphon recorder with the signals of the same size, the same definition, and the same sending battery as at present, but at a greater speed.

3. I believe it may be used to work over a cable under the same conditions as regards speed and battery power as at present, but the signals may be written by a "direct writing recorder" in place of the present "siphon recorder."

Now I should like to suggest a use for this instrument or part of the instrument for electrical engineers other than telegraph men. Referring again to fig. 7, and considering only that part marked B *b*: If the winding round the magnet is supplied with an alternating current, say, of sine wave form, we have seen that if induction or capacity is introduced in the circuit of *b*, the rectifier being dispensed with, the current flowing in the circuit will be put out of phase with the induced volts, and a mechanical reaction takes place between the coil *b*, and the magnet B, the coil tending to move one way for induction, and in the opposite way for capacity, *b* being supposed suspended in such a manner as to cut some of the moving magnetic lines, its motion being studied by means of a mirror reflecting a spot of light on to a scale.

A complex circuit could be tested and compared with a standard, the deflection showing the resultant capacity or induction; or, perhaps, the capacity, say, of such a thing as a coherer, could be found out by this means. I believe that such a reaction galvanometer could be worked up to measure capacity and induction in the same way as an ordinary galvanometer measures resistance.

Messrs. H. A. Taylor and A. L. Dearlove, both of the firm of Messrs. Clarke, Forde & Taylor, pointed out this line of investigation to me. They gave the convenience and necessary encouragement, and have done all in their power to help me in every possible way, and I wish to acknowledge my deep indebtedness to them.

M. HOSPITALIER'S ONDOGRAPH.

(*Concluded from page* 971.)

In the apparatus intended to trace the curve of instantaneous power, instead of the permanent magnet measuring apparatus, a Thomson meter is used, mounted as a wattmeter; the axis is submitted to the action of two spiral springs which bring the current to the movable coil, thus dispensing with the brushes. The main current traverses the fixed coils, and the movable coil of fine wire is connected in shunt once each period and for a very short time by means of the commutator and the brushes, with the difference of potential defining the power to be measured. For this purpose the rotating commutator consists of an ebonite cylinder in which is inlaid, parallel to the axis, a simple band of brass of convenient width. Under the influence of the successive impulses, which the coil receives, by the inter-action of the intermittent currents which traverse it, and of the main alternating current, the bobbin makes with its position of equilibrium an angle proportional to the power at each instant of the period defined by the position of the commutator, and affects directly or indirectly the pen of the registering apparatus. This proportion results from the fact that the angle described by the movable bobbin about its position of equilibrium never exceeds 10 to 12° each side of zero; under these conditions the drum winding of the wattmeter can be considered as not having undergone any sensible displacement with regard to the fixed coils.

The aluminium disc of the meter serves to give to the system the inertia and damping necessary to the normal working of the apparatus. This normal working corresponds to the critical damping on the one hand, and on the other hand to a duration of oscillation comprised between the period of the phenomenon to be registered, and the duration of the registration of one period.

The ondograph, as it is and as represented by fig. 2, which appeared in our last issue, is intended to trace a complete period by using 1,000 actual periods. The registering cylinder inscribes exactly three periods, the fourth superposes itself on the first and the fifth on the second, &c.; the superposition of the curves is a certain indication of the good working of the apparatus, apart from deviations resulting from a change in the rate of running supervening between the 3,000 periods which separate two successive passages of the same generating line of the registering cylinder under the pen.

The curves can also be traced on a strip extended to a length of several metres. For convenience it is sufficient to attach the extremity of a roll of paper on the registering cylinder and to let it roll itself on the cylinder while holding it by a weak brake. With the actual apparatus and with a frequency of 40 periods per second, a complete curve occupies a length of 96 mm., and is recorded in 25 seconds. A strip 6 m. in length then will contain 60 periods and records for a period of 25 minutes, which is usually quite sufficient. The apparatus is equally suitable for the study of rectified or continuous currents. It is sufficient for that to substitute for the synchronous motor a direct drive by establishing an invariable mechanical connection between the shaft of the machine to be studied and the ondograph. The apparatus has been designed with a view to making its construction easy and rapid.

In designing the ondograph—or, for purists, the kymatograph—the author intended to fill a purely industrial and educational want. The apparatus is strong, relatively moderate in price, easily managed, more exact than the method of points, less delicate and more rapid than the oscillograph or rheograph, without, however, pretending to the degree of precision attained by those machines.

The ondograph will, above all, be useful to manufacturers of dynamos, motors, and transformers for central stations with alternating current; to manufacturers of high pressure cables, who must be interested to know the form of the alternating currents to which their cables are subjected; to industrial schools and research laboratories, and to educational laboratories, for which it would at once render visible facts, of which the explanation is often so difficult and laborious. The author has already shown for the benefit of the Ecole de Physique et de Chimie Industrielle, at Paris, a great number of curves.

Note.

Forerunners.—The application of the method of successive points to the study of alternators is due to M. Joubert.* The condenser was applied by the author in 1885 to the study of M. Anatole Gerard's dynamos with rectified current.†

On March 20th, 1891, at the session of the Sté. Française de Physique, M. G. Weiss said that he was using an apparatus to define by points, or in a continuous manner the form of the wave of a dynamo, but he did not describe the apparatus. M. P. Janet announced at the same *séance* that he was undertaking researches of the same kind, but without describing any device.

M. Blondel has claimed the invention of a registering apparatus which traces curves well, but these curves are recorded photographically, and not direct, in ink, on a registering cylinder. Further, the brushes are movable, while ours are stationary, and the apparatus requires as many distinct galvanometers as curves to be registered, while the author uses only one registering apparatus for all the curves. M. Blondel's apparatus‡ is driven direct by the generating dynamo, while the ondograph is actuated by a synchronous motor, which allows of being rapidly introduced at any point of the circuit, and of dispensing with the clockwork movement controlling the stroboscopic device.

* J. Joubert. "Studies on Electro-Magnetic Machines." *Ann. de l'Ecole Normale Expérieure*, Vol. x., p. 131. 1881.

† E. Hospitalier. "Periodic Current Machines and their Measurement." *L'Electricien*, December 19th, 1885.

‡ A. Blondel, "On the Determination of the Periodic Curves of Alternating Currents and their Photographic Record," *La Lumière Electrique*, Vol. xli., pp. 401 and 507, 1891.

In M. Drexler's apparatus* the slip is obtained by an asynchronous motor, and the record is obtained by sparks. The slip of an asynchronous motor is too variable and too great to be usefully employed for direct stroboscopic recording, and the device does not allow of the exact junction of successively traced curves, since the slip is not kinematically connected with the rotation of the registering cylinder.

M. A. Laws† replaces the asynchronous motor by a synchronous motor, and gives a slight angular retardation to the brushes, making them turn by a gearing arrangement; the recording is again done photographically. The only apparatus tracing an alternating current curve direct on a registering cylinder is that of Prof. H. L. Callendar.‡ The apparatus is based on the principle of the potentiometer and of registering by relay and servo-motor well known to the author. The cylinder is actuated by a clockwork movement, and the record of a curve is made in one hour, while the author obtains the same record in between 10 and 30 seconds.

The ondograph is distinguished from its predecessors by the fact that it traces a continuous curve direct on registering paper, without photography, without a clockwork movement, without relay, without making the brushes turn, and without using the slip, necessarily variable, of an asynchronous motor working on no load.

E. H.

THE EDISON STORAGE BATTERY.

By HENRY F. JOEL, A.M.I.C.E.

An examination of the patents and claims for "reversible galvanic cells," taken out by Mr. Edison in the United Kingdom, will, perhaps, afford the most reliable data for estimating the value of the improvements he has made, the patent specification being the inventor's own description. Apart from the commercial side of the inventions, the specifications are most interesting to the electro-chemist, metallurgist, and the manufacturer of electromobiles.

In speaking of the Edison battery, there is some confusion as to which battery is meant. Mr. Edison has taken out four patents in 1900 and 1901, and I give below a brief analysis of them:—

The Edison Storage Battery Patents.

Date and number.	Elements.			E.M.F. Volts.	Output in watt-hours per 1 lb. of cell. Stated to be	Notes.
	Positive plate (depolariser).	Electrolyte.	Negative plate.			
November 20, 1900, No. 20,960.	Nickel or metal plated with nickel, for supporting plate with pockets containing blocks of finely divided copper.	Alkaline solution. Ten per cent. solution of pure sodic hydroxide.	Nickel, or metal plated with nickel, for supporting plate with pockets containing finely divided cadmium.	·44	—	Also made into a "dry battery" by placing sheets of asbestos between the plates.
February 5, 1901, No. 2,490.	Perforated sheets of thin nickel to form a container with oxide of nickel inside (or oxide of cobalt) mixed with flake graphite 7 to 3.	Twenty-five per cent. solution of potassic hydroxide in water.	Perforated sheets of thin nickel to form a container with ferrous oxide inside.	1 to 1·38	14	Stated to be 1 to 1·5 volts by Dr. Kennelly.
May 21, 1901, No. 10,505.	Sheet steel frame or plate holding pockets made of thin sheet steel, perforated, corrugated and nickel plated, containing non-colloidal nickel oxide mixed with flake graphite.	Alkaline solution.	Sheet steel frame or plate holding pockets made of thin sheet steel, perforated, corrugated and nickel plated, containing ferrous oxide mixed with flake graphite.	1 to 1·4	12	Stated to give 1 H.P.-hour for 53 lbs. of battery. Each cell 12 in. high, 6 in. long, 4 in. wide. 21 cells weigh 332 lbs., *i.e.*, 15·8 lbs. each cell. Car run 62 miles. *Vide* daily press.
October 8, 1901, No. 20,072.	Sheet steel frames or plates holding perforated steel pockets all nickel plated, containing nickel hydroxide (or cobalt hydroxide, or copper oxide) mixed with flake graphite.	25 per cent. solution caustic soda, to which zinc has been added until it is nearly saturated.	Magnesium conducting and supporting plate perforated with fine holes, coated with zinc during process of charging.	·75 to 1	—	Volts uncertain. With copper oxide forms Edison-Lalande couple, but reversible.

It is evident from this analysis that Edison sticks very closely to his first love, the Edison-Lalande battery, and generally the new batteries ring the changes on that iron-copper and zinc battery known as "the Alkaline Zincate genus."

The disadvantages that are at once apparent on examining the table are:—the low electromotive forces, necessitating double the number of cells that a lead-lead battery requires, the use of caustic soda, the comparatively expensive elements and the complex and expensive mechanical construction; on the other hand, the advantages claimed for the nickel-iron battery, such as great durability and long life—it is stated there is no, or very little, waste in the elements during charge and discharge—little or no action on the metal containing cells and connections, which are therefore more reliable, and the great output of this form of battery for its light weight:—all make it worth the serious attention of those interested in the future of electric vehicles.

To go more fully into the details, in his Patent No. 20,960, 1900, Edison states that he is aware that copper oxide was used as a depolariser, but owing to the production of a copper salt, which caused local deteriorating action with the zinc, it was necessary to use porous pots; but these were not successful, and, as a consequence, copper oxide as a depolariser has never remained in commercial use. He has discovered that when the copper is specially made, and used in a very finely divided form, the production of the soluble salt is entirely overcome, "since the effect of the current is to make anhydrous and insoluble in alkaline liquid any copper oxide which may be formed."

Preferably, the finely divided copper is obtained by reducing fine carbonate of copper by hydrogen. This is made into thin blocks to fit into the pockets of the plates, and these are then subjected, in a closed chamber, to a temperature not to exceed 260° C., for six to seven hours, until the copper is converted into the black oxide (CuO). They

* F. Drexler, "On a New Method for the Self-acting Record of Alternating Current Curves," *Zeitschrift für Electrotechnik*, No. 8, 1896.

† A. Laws, "Alternating Current Wave Recorder," *Western Electrician*, February 23rd, 1901.

‡ Hugh L. Callendar, "An Alternating Cycle-Curve Recorder," the *Electrician*, August 29th, 1898.

are then reduced electrically to metallic copper, and then again re-oxidised on charging by the current until they are converted into the red oxide (Cu_2O).

The finely divided cadmium is preferably obtained by an electro-deposition process, a very thin platina wire being used as the cathode, a plate of metallic cadmium as the anode, and a weak solution of sulphate of cadmium as the electrolyte.

Edison states:—"The voltage of my improved battery is ·44 volts. Its internal resistance is extraordinarily small. Furthermore, exhaustive tests which have been made have

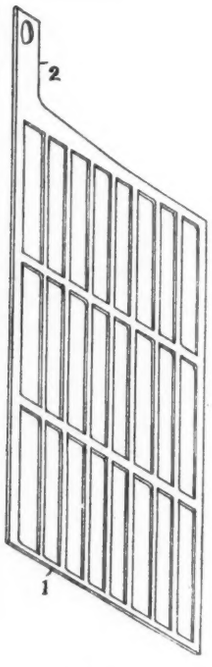


Fig. 1.

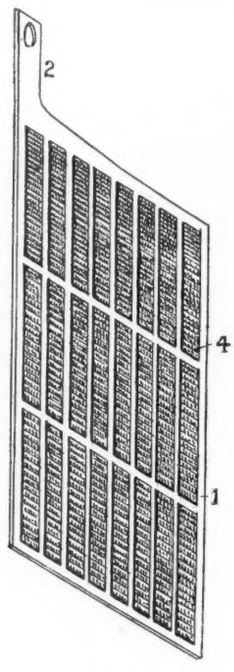


Fig 2.

demonstrated that there is practically no deterioration, since neither nickel, cadmium, nor copper, nor their anhydrous first oxides are soluble in the alkaline liquid, while there is no local action between the metallic cadmium and nickel, as the latter polarises completely."

Edison claims:—1. "A reversible galvanic cell, employing copper oxide as a depolariser formed in the cell by the electrical oxidation of finely divided copper of such a density as to prevent the formation of a copper salt soluble in alkaline solutions," and also Claim 2 for the process of making the finely divided copper.

Claim 3.—"A reversible galvanic cell characterised by the employment of finely divided cadmium as the active element in an alkaline solution," and also Claim 4 for the process of making the finely divided cadmium.

Claim 5.—"A reversible galvanic cell, characterised by the employment of nickel or nickel-plated plates for carrying the elements," and, further, Claim 6, for the employment of sheets of asbestos between the elements, moistened with the alkaline solution, to form a dry battery of the reversible type.

The Patent No. 2,490, 1901, comes next in order. Edison describes a method of making finely-divided iron, which on oxidation and reduction, remains insoluble and permanent, and "the electrolyte is not changed at any stage of the working." He claims:—

1. In a reversible galvanic battery, the use of the oxides of nickel or cobalt as one of the active elements.

3. In a reversible galvanic battery, the use of finely-divided iron as one of the active elements.

8. In a reversible galvanic battery, or receptacle for containing the active elements, said receptacle being formed of iron, nickel plated, so as to be unaffected by electrolytic action in an alkaline solution.

The other claims cover the construction and details, but as the succeeding patent practically supersedes this patent, and is an improvement and enlargement thereof, I have not gone so fully into the specifications, although there are many interesting features.

The battery as constructed in the Patent No. 10,505, 1901, is the one euphoniously described in the Press as having tiny bricks of nickel and steel, and as it is the battery Edison has apparently chosen as the fittest, I give rather a fuller description, obtained from the patent specification.

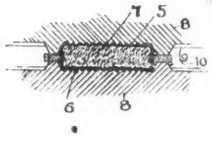


Fig. 6.

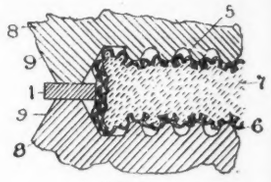
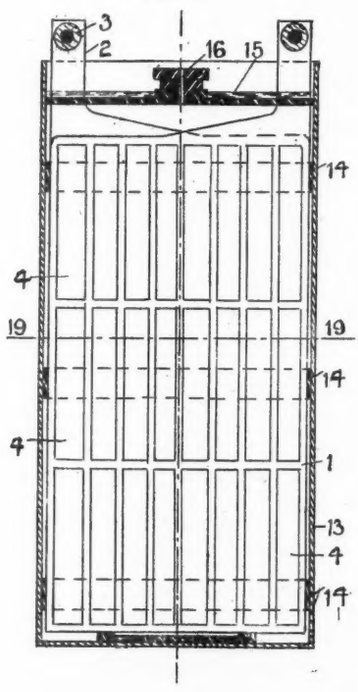


Fig. 9.

Fig. 1 is an isometric view showing one of the grids, or plates with the openings therein. Fig. 2, a corresponding view showing the perforated pockets in position in such openings. Each electrode frame, or grid 1. fig. 1, is punched out of sheet steel, about ·625 mm. in thickness, and has 24 apertures, or openings for receiving the perforated pockets as shown. Its entire surface is electro-plated with nickel; Edison states:—"Nickel is not electrically oxidizable in an alkaline solution," an extension or ear 2, serves to conduct the current, a perforation at the top permitting the passage of a conducting rod 3, see fig. 17, connecting all the

Fig. 17.



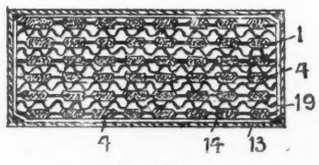


Fig. 18.

positive electrodes in a cell, the alternate negative electrodes being similarly connected. Secured in the openings of the grid or plate are 24 pockets, 4, shown in fig. 2, each pocket containing the active material ready for immersion in the electrolyte. Fig. 6 shows one of the pockets under compression being forced into one of the openings in the grid.

Fig. 9 is an enlarged section of fig. 6, the end of one of these pockets, and shows the resulting shape obtained by the compression.

The pockets 4 are formed from corrugated perforated strips, produced by passing a ribbon of thin sheet steel between male and female perforating punching rolls, and afterwards between two toothed rolls; these strips are bent over at their edges, one half or side, a little more than the other, to allow them to fit together to form a case 5, 6, or pocket, with a cake, or plate of the active material 7, between them, and these pockets are then placed in position, each into one of the 24 openings 1, on the grid, fig. 1, and the whole plate is subjected to great pressure in an hydraulic press between two plates 8 and 9, whose faces are provided with parallel corrugations and arranged in such a manner that the two cups of each pocket 5, 6, with the plate of active material between them, will be subjected to a total pressure of about 90,000 kilograms (about 90 tons). The result of this great pressure is to force down the two faces 5 and 6 of each cup upon the plate of active material, to form larger, or compound corrugations, shown in fig. 9, and to force and crimp the edges of the pockets over the edges of the corresponding opening in the grids. This secures the pocket rigidly in place to the grid, making each pocket a mechanically-closed receptacle, and forcing the active material 7 in contact with every portion of the inner surface thereof. The pockets being made of thin sheet steel with corrugations are sufficiently flexible to allow the active material to expand and contract whilst the additional corrugation and crimping at the edges gives it strength.

Fig. 17 shows a section of a complete cell, and fig. 18 a plan of same. The cell is made of thin sheet iron, 13, nickel plated, the electrodes being held together by rubber bands, 14, and insulated electrically from each other by corrugated perforated plates of hard rubber 19. Edison states :— "As I have explained in my said prior application ferrous oxide of all the compounds of iron is alone capable of being practically reduced to the metallic state electrolytically in alkaline solution, but it is exceedingly sensitive to atmospheric oxidation, taking fire spontaneously when exposed to the air, it is a very difficult compound to make and handle."

He describes his process, first to subject ferric oxide to a temperature of about 260° C. in a closed chamber, and pass dried hydrogen gas over it for two or three hours, then allow it to cool whilst the hydrogen gas is still passed over it for a further 15 hours, the object being to prevent the spontaneous combustion of the oxide when it comes in contact with the atmosphere. The continued action of the hydrogen performs some obscure and unknown effect which renders the oxide non-pyrophoric. Another method of obtaining a compound containing a large proportion of ferrous oxide is by heating thin sheets of Norway iron in a muffle to white heat, to form a scale rich in ferrous oxide, and then to detach the scale by bending the plate. Edison particularly states that ferric oxide is not suitable, and is only partly convertible, by electrolytic process into iron; it must be the ferrous oxide, and that is mixed with the flake graphite to ensure as large a conducting and active surface as possible, the graphite not being otherwise affected.

I give the claims of this patent in full as they are the most important.

Claim 1.—A reversible galvanic battery of the type employing an alkaline electrolyte, whose negative electrode or oxydisable element is characterised by the employment of anhydrous ferrous oxide, which is reducible to the metallic state electrolytically.

Claim 2.—An improved reversible galvanic battery employing an alkaline electrolyte and characterised by the use, in the make-up of its positive pole electrode, of a depolariser consisting of a non-colloidal hydrated oxide of nickel, as distinguished from the colloidal form of such oxide produced by the usual methods.

Claim 3.—A reversible galvanic battery employing perforated receptacles as explained for holding the active material of the electrodes, and characterised by the admixture with the active material of flake-like non-active conducting material, such as micaceous graphite, the particles of which are larger in size than the perforations in the receptacle, the surface of such flakes being coated with a finely divided active material by pressing the two materials together while in a plastic state and in such a manner that the size of the flakes shall not to any considerable extent be diminished to enable them to pass through such perforations, and the relative proportion of the two materials being such that substantially all the active material will be in electrical contact with the surface of the conducting flake-like material.

Claim 4.—An improved reversible galvanic battery employing an alkaline solution and characterised by the use of perforated receptacles for containing either of the active materials or for separately containing both of the active materials, which are sustained within the receptacle under pressure, the receptacles being made of an elastic metal, such as spring steel, nickel-plated or not as may be desired, the elasticity of the walls of the receptacles being so proportioned relatively to the expansive and contractive tendencies of the active material, that any increase or diminution in the bulk of the active material shall be included within the elastic limits of such walls, so that continuous contact will be maintained between the active material and the containing receptacles, regardless of expansion or contraction of the active material.

Claim 5.—An improved reversible galvanic battery having the general characteristics above recited and further characterised in that each perforated receptacle is crimped around the edges of an appropriately shaped opening in a suitable supporting grid or plate, as set forth.

Claim 6.—An improved reversible galvanic battery having the before recited characteristics and further characterised by the corrugating of the outer walls of the metal receptacles to increase the strength and thereby permit the use of thinner material.

Claim 7.—An improved reversible galvanic battery having the before-recited characteristics and further characterised by making the receptacles of two cups or sections, one having deeper sides than the other, so that when the sections are subjected to compression to crimp them in position in the supporting grid or plate, the deeper walls of the first section will be crimped over upon the bottom of the other section to lock the sections rigidly together and to the grid or plate, as set forth, and each cup being formed from blanks cut from a perforated metallic ribbon having imperforate margins, the side edges of each cup being located outside of the perforations.

The patent specification, No. 20,072, 1901, describes the use of the metal magnesium as the receiver of the plated and active metal zinc. Edison states: "I have found from experiment that zinc is deposited in spongy form on different metals from an alkaline solution, largely because of local electric action between the zinc and such metal," and this causes the deposit to be non-adherent and ineffective. Amalgamating with mercury prevents the local action to some extent, but not thoroughly. He says further: "I find that in practice the magnesium is not attacked, but remains absolutely neutral. There is no local action between the two metals, and neither hydrogen nor zinc hydroxide is formed." "With my improved battery the zinc is plated out of the solution upon the magnesium support in a dense and adherent form, and even with a large volume of current, very considerable amounts of zinc can be thus deposited before the surface assumes a non-coherent character. I cannot explain why the magnesium is not attacked, and why local action does not take place thereon, as ordinarily magnesium is much more oxidizable than zinc. I believe, however, as a result of numerous experiments, that the phenomenon is satisfactorily explained by the supposition that the magnesium is coated with an extremely thin layer of oxide insoluble in the liquid, and that the zinc is deposited upon said film of oxide, and not upon the metal itself. If this supposition is correct, then the electric charges of the zinc ions apparently pass to the metal through this layer." Edison claims the use of the metal magnesium upon which the active metal is electro-deposited, and also the combination with a nickel-oxygen depolariser.

It will not serve any useful purpose to criticise and compare the Edison patents and processes described therein, with resuscitated old patents and similar processes. Mr. Edison is a worker, and his patents bear evidence of his hard plodding work, and of the patience and perseverance he has given to this subject. He has undoubtedly advanced our

knowledge of the alkaline genus tribe of storage batteries, and of the special preparations of metals, copper, iron, nickel, and zinc for use with such solutions. The reading of the specifications come fresh, and brings one up to date.

The comparison of his iron-oxide of nickel battery as to first cost, output, and cost of upkeep, with the lead-oxide of lead battery, and with other batteries in the market, will be of interest, and I propose to deal with this part of the subject in a further article.

NEW PATENTS AND ABSTRACTS OF PUBLISHED SPECIFICATIONS.

NEW PATENTS, 1902.

Compiled expressly for this Journal by W. P. THOMPSON & Co., Electrical Patent Agents, 322, High Holborn, London W.C., and at Liverpool, to whom all inquiries should be addressed.

12,483. "Means for operating electrically the signals on electric railways and tramways." J. P. TIERNEY and J. MALONE. June 2nd.

12,511. "A new or improved method for cleaning and burnishing electro-plated articles, silver, steel and other metals." R. T. MENCE. June 2nd.

12,517. "Improvements in multiplex telegraphy." G. L. HOGAN. June 2nd.

12,536. "Improvements in connection with electric tramcars." J. BLACK and T. HOGG. June 2nd. (Complete.)

12,547. "Improvements in making electrolytic baths." F. VON LIEBERMANN. June 2nd. (Complete.)

12,554. "Improved means and apparatus for telephonic communication." SIEMENS BROS. & Co., LTD. (Siemens & Halske, Aktien-Gesellschaft, Germany.) June 2nd. (Complete.)

12,556. "Improvements in thermo-electric batteries." H. KIEFER. June 2nd.

12,570. "Improvements in and relating to telephonic instruments." I. B. BIRNBAUM. June 2nd. (Complete.)

12,578. "Improvements in current reversing mechanism for oscillating electricity meters." P. M. JUSTICE. (Theiler & Co., Switzerland, and P. Eibig, Germany.) (Complete.) June 2nd.

12,581. "Improvements in electric traction apparatus." A. ZEHDEN. June 2nd. (Complete.)

12,582. "An improved system of electric lighting." W. L. WISE. (The Moore Electrical Company, United States.) June 2nd. (Complete.)

12,607. "Improvements in or relating to electric tramcars and the like." W. G. INGLEFIELD and H. G. HACKETT. June 3rd.

12,624. "Improvements in dynamo-electric machines and motors." W. R. V. MARSHALL. June 3rd.

12,671. "Improvements relating to telephone systems." C. G. BURKE. June 3rd. (Complete.)

12,688. "Improvements in or relating to polyphase current transformers." W. P. THOMPSON. (Berliner Maschinenbau-Actien-Gesellschaft, vormals L. Schwartzkopff, Germany.) June 3rd. (Complete.)

12,689. "Improvements in and relating to combinations of electric switches and wall plugs." A. VANDAM. June 3rd.

12,691. "Improved process for the electrolytic decomposition of alkaline chlorides and apparatus therefor." H. CUENOD and C. FOURNIER. June 3rd.

12,694. "Improvements in or relating to coils for dynamo-electric machines." L. LOHNER and F. PORSCHE. June 3rd.

12,697. "Improvements in perforators for use in connection with automatic telegraph transmitters." A. MUIRHEAD. June 3rd.

12,700. "Improvements relating to the manufacture of active material for the plates of electric accumulators." S. A. ROSENTHAL. June 3rd.

12,702. "Improvements in the electrical production of iron alloys with the simultaneous production of alkaline oxides and alkaline earths." G. GIN. June 3rd.

12,706. "Improvements in wireless telegraph systems." C. D. EHRET. June 3rd. (Complete.)

12,733. "Electric door contact." F. E. LINNETT. June 4th.

12,737. "Improvements in or relating to blowing-off machines for electric lamp bulbs." A. SWAN. June 4th. (Complete.)

12,738. "Improvements in or relating to means or apparatus for effecting an all glass seal between the stem which carries the filament of an incandescent electric lamp and the enclosing bulb." A. EWAN. June 4th. (Complete.)

12,739. "Improvements in or relating to bases for incandescent electric lamps, and in means or apparatus for manufacturing the same." A. SWAN. June 4th. (Complete.)

12,749. "An improvement in electrical communications for railways and other purposes." C. M. A. CULVERHOUSE and F. V. CULVERHOUSE. June 4th. (Complete.)

12,752. "Improvements in testing the insulation of electric cables." E. A. CLAREMONT and C. J. BEAVER. June 4th.

12,755. "Method for reducing or entirely suppressing synchronising currents of single or multiphase alternators working in parallel." E. KOLBEN. June 4th. (Complete.)

12,764. "Improvements relating to brush-holders for dynamo-electric machines and similar apparatus." H. H. LAKE. (General Electric Company, United States.) June 4th.

12,765. "Improvements in and relating to the distribution of electricity." H. H. LAKE. (General Electric Company, United States.) June 4th.

12,766. "Improvements relating to apparatus for cleaning electric lamp filaments." H. H. LAKE. (General Electric Company, United States.) June 4th.

12,767. "Improvements relating to the control of electric motors." H. H. LAKE. (General Electric Company, United States.) June 4th.

12,783. "An improvement in electro-magnetic detents." SIEMENS BROS. and COMPANY, LIMITED, and A. SIEMENS. June 4th.

12,793. "Improvements in the electrolytic refining of copper." THE METALS CORPORATION, LIMITED, and S. COWPER-COLES. June 4th.

12,823. "Improvements in electrical measuring instruments." A. C. HEAP and W. O. SMITH. June 5th.

12,857. "Improvements in and relating to storage batteries." W. E. WINSHIP. June 5th. (Complete.)

12,870. "Improvements in or connected with apparatus for charging electric accumulators." SOCIETE LESPAGNOL and MERIGUET. (Date applied for under Patents Act, 1901, November 14th, 1901, being date of application in France.) June 5th. (Complete.)

12,951. "Improvements relating to electro-magnetic switches." O. SCHWIMMER, I. SCHON and M. B. SCHWIMMER. June 6th.

12,956. "Improvements in transmitting apparatus for electric telegraphs." P. M. JUSTICE. (The Rowland Telegraphic Company, United States.) June 6th.

12,958. "Improvements in switches for electric motors." H. H. LAKE. (General Electric Company, United States.) June 6th.

12,959. "Improvements in machines for winding insulating tape on the coils of electrical apparatus." H. H. LAKE. (General Electric Company, United States.) June 6th.

12,960. "Improvements in electrical conductors." H. H. LAKE. (General Electric Company, United States.) June 6th.

13,037. "An improved coin-freed machine or apparatus for administering electricity." J. JOFEH. June 7th.

ABSTRACTS OF PUBLISHED SPECIFICATIONS.

Copies of any of these Specifications may be obtained of Messrs. W. P. Thompson and Co., 322, High Holborn, W.C., and at Liverpool, price, post free, 9d. (in stamps).

1900.

6,848. "Improvements in polyphase induction motors." B. G. Lamme. Dated April 12th, 1900. Relates to polyphase induction motors in which two or more independent windings are provided, in order that rotating fields having different numbers of poles may be produced, and the motor enabled to run at two or more different speeds. 2 claims.

6,951. "An improved instrument for measuring electric currents." J. J. Steele. Dated April 12th, 1900. A tapered iron core is suspended from an arm of a horizontal bar, which is supported only by the inner ends of two or more flat spiral springs, their outer ends being clamped on a support fixed adjustably on a slotted back plate by a screw. One end of the horizontal bar is formed into a pointer which moves in front of a graduated arc. An extension of the core moves with a little friction in a perforated guide. The core is acted on by a stationary coil; they may be replaced by equivalent devices. The instrument may be used as ammeter or voltmeter. 6 claims.

6,974. "An improved system or means for controlling or regulating electrical installations." W. P. Thompson. (C. Loerper, Germany.) Dated April 12th, 1900. At central stations the electrical controlling apparatus and the mechanical controlling apparatus are placed in close proximity. The subsidiary devices, which do not require attention, are placed under the floor or engine foundation in order to avoid crowding.

7,070. "Improvements relating to telephones." J. C. Kneale and Hartley. Dated April 12th, 1900. A telephone receiver is combined with a microphone by forming an iron case with a central cylindrical projection acting on its hollow side as a cavity for the carbon granules and otherwise as the cone for the coils. The microphone is closed by a dampiog ring and carbon disc bearing against the diaphragm; a buff is also employed in the bottom of a tube. The coils act as a secondary and primary in an induction coil; the secondary also forms the receiver coil. The microphone is provided with a curved mouthpiece, and the apparatus is adapted to rest on a stand provided with the ordinary switching contact. The provisional specification also refers to the microphone being separate from the receiver. 6 claims.

7,082. "Improvements in printing telegraphs." L. Cerebotani and C. Moradelli. Dated April 17th, 1900. A tape printing telegraph consists of transmitting and receiving apparatus modified from those described in Specifications Nos. 10,040 and 20,389, A.D. 1899, so that the printing of each letter is effected by a succession of similar currents, without the use of different relays, such as those described in Specification No. 13,729, A.D. 1896. 4 claims.

7,084. "Improvements in or relating to electric motors." A. J. Boult. (O. H. Pieper and A. F. Pieper, U.S.A.) Dated April 17th, 1900. An alternating current motor is constructed with field windings, armature coils, commutator and brushes all connected in series, as customary in constant current motors. For the purpose of controlling the motor a permanent shunt containing a variable resistance is connected across the brushes. Sparking at the brushes is prevented, and the power factor is increased by connecting the armature coils to the commutator sections through resistance coils, which are wound on the armature core. 7 claims.

7,098. "Improvements in or relating to multipolar electric machines." S. Short. Dated April 17th, 1900. In a multipolar machine a balancing effect is obtained, and sparking prevented, by connecting together a number of points on the armature winding, similarly situated with reference to the field poles by means of a low-resistance conductor, such as a copper ring. The effect may be improved by connecting together a number of other symmetrically-disposed points by means of a second ring. The brushes are connected alternately to the rings. 4 claims.

7,100. "A new or improved device for fixing incandescence electric lamps." L. J. P. Hollub and H. Mignal. Dated April 17th, 1900. A lamp bulb is made with a flat projection carrying contact plates, or the bulb may carry a similarly formed metal projection. The upper part of a metal cap is slit longitudinally to form spring tongues which grip the neck of the bulb. The cap contains a plate slotted so that the projection can be passed through it and beat up at the sides of the slot to hold the projection, as shown when the lamp is turned through a right angle after being placed in the cap. The cap may be provided with pins to engage a bayonet-joint holder, or with a projecting edge and a loose coupling ring to screw on a holder, so that the plates bear on spring plungers. 1 claim.

7,106. "Improvements in electric railways on a surface contact system." J. M. Murphy. Dated April 17th, 1900. Electric railways and tramways on a sectional conductor system with electro-magnetic switches. The switch magnets have fine wire and thick wire windings, and the head of the armature is always in contact with the contact connected to the sectional conductors. The switch is excited in the first instance by a battery current from the vehicle flowing through the sectional conductor contacts, spring plate and fine wire winding to the return. This circuit is broken when the armature moves away from the adjustable plates, but the main circuit is then completed between the contacts through the thick coils from the feeder to the vehicle. To supply the battery current the driver's controller has, in addition to the regular resistances and reversing contacts for the motor, two steps which work on to the trolley and the battery contacts, so that the battery first supplies and then receives current from the trolley, which runs on the sectional conductors. 3 claims.

7,108. "Improvements in or connected with magneto-electric machines." F. R. Simms and R. Bosch. Dated April 17th, 1900. A magneto-electric machine, chiefly for use in connection with electric ignition devices for internal combustion engines, is so arranged that the armature or an inductor enclosing the same shall be continuously rotated, either directly or indirectly by the motor crankshaft. 4 claims.

7,109. "Improvements in electro-magnetic coils." R. Varley. Dated April 17th, 1900. An electro-magnetic coil is constructed by winding bare wire in layers on a tubular paper core, adjacent convolutions being insulated from one another by an insulating strand fibre, or by a covered wire. Successive layers are separated by thin paper tubes, and the core is composed of paper saturated or coated with paraffin. 4 claims.

7,133. "Improvements in electric incandescence lamps." H. H. Lake. (S. D. Washburn and C. H. Tinkham.) Dated April 17th, 1900. A reflector is supported within a lamp held by a glass tube sealed at its inner end by the leading-in wires, and at its outer end by the neck of the bulb. The filament is preferably helical, with its axis parallel to the surface of the reflector. 1 claim.